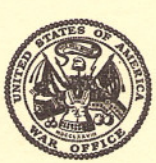
DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

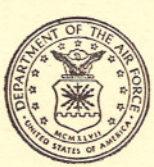
TM 9-1901-1

DEPARTMENT OF THE
AIR FORCE TECHNICAL ORDER

TO 11A-1-39

AMMUNITION FOR AIRCRAFT GUNS





DEPARTMENTS OF THE ARMY AND THE AIR FORCE

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This manual is correct to 21 August 1957

***TM9–1901–1/TO 11A–1–39**

TECHNICAL MANUAL No. 9–1901–1
TECHNICAL ORDER No. 11A–1–39 *

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

WASHINGTON 25, D. C., *18 December 1957*

AMMUNITION FOR AIRCRAFT GUNS

***This manual supersedes those portions of TM 9–1901 (TO 11A–1–22), 11 September 1950, including Changes No. 1 (TO 39B–1–20), 12 March 1954, that pertain to ammunition for aircraft guns.**

CHAPTER 1

GENERAL

Section I. INTRODUCTION

1. Purpose and Scope

This manual is intended for instruction and the dissemination of general and technical information concerning ammunition for aircraft guns (cal. .50 machine guns and 20-mm guns). This manual covers the general characteristics of ammunition for aircraft guns, specific data, means of identification, precautions in handling and use, and general information on packing. General technical information pertaining to all types and kinds of conventional ammunition and explosives is contained in TM 9–1900/TO 11A–1–20. General information on care, handling, preservation, storing, and shipping of ammunition and explosives, and their demolition to prevent enemy use is contained in TM 9–1903/TO 11A–1–37. Small-arms cartridges with detailed data are covered in TM 9–1990/TO 11A–13–1–101. These publications should be available for use as required in connection with this manual.

2. Arrangement of Text

a. Sections I and II of chapter 1 cover purpose and scope, arrangement of text, definition, classifications, standard nomenclature, Federal stock number and Department of Defense Identification Code, classification of ammunition for aircraft guns, means of identification, grade of ammunition, explosive charges, and packing and marking for shipment.

b. Section I of chapter 2 presents specific data for ammunition for caliber .50 aircraft guns.

c. Sections II through IV of chapter 2 deal with specific data on ammunition for 20-mm guns M3, M24A1, M39, M39A1, and M61 (T171E3).

d. Chapter 3 describes fuzes, propelling charges, and primers for ammunition for aircraft guns.

e. Chapter 4 presents methods for the demolition of ammunition to prevent enemy use.

f. A list of references is given in the appendix.

Section II. GENERAL DISCUSSION

3. Definitions

Ammunition for caliber .50 and 20-mm aircraft guns is classed as fixed ammunition. Certain components have the same nomenclatures while the missiles are known as projectiles in 20-mm cartridges and as bullets in caliber .50 small-arms ammunition. A round of fixed aircraft ammunition consists of a cartridge case, a projectile or bullet, a quantity of propellent grains, and a primer. Certain 20-mm projectiles contain high explosives and are assembled with point-detonating fuzes. Upon impact of the percussion firing pin or upon closure of the electrical circuit, the composition within the primer is detonated; flames thereof in turn ignite the propellent grains. The high pressure of the generated combustion gases forces the projectile or bullet out of the cartridge case and drives this missile out of the weapon at high velocity. Upon impact, the fuze causes initiation of the explosive with certain 20-mm projectiles. Initiation of incendiary composition within other type projectiles or bullets is caused by the crushing force and heat generated upon impact. Throughout storage, feeding, and firing, the cartridge case acts as a container for the other cartridge components and also, during firing, prevents the rearward escape of propellent gases. As indicated by its classification of fixed ammunition, such cartridges are manufactured for issue and are as self-contained units; disassembly, modification of the propellent charge, and/or change of projectiles is not intended.

4. Classification

a. Caliber .50 ammunition is classified according to type as ball, armor-piercing, incendiary, tracer, armor-piercing-incendiary, armor-piercing-incendiary-tracer, blank, dummy, and high-pressure test. Caliber .50 ammunition is classified according to use as service and special, which includes training and test ammunition.

b. Twenty-millimeter ammunition is classified according to type as armor-piercing, armor-piercing-incendiary, armor-piercing-incendiary-tracer, ball, high-explosive with incendiary, incendiary, dummy, high-pressure test, and target practice. Twenty-millimeter ammunition is classified according to use as service and special, which includes training and test ammunition.

5. Standard Nomenclature

Standard nomenclature is established in order that each item supplied may be identified specifically by name. Standard nomenclature consists of an item name, a colon, and additional item identification established in accordance with Federal Item Identification Guides for Supply Cataloging. For ammunition for aircraft guns, other than blank and dummy ammunition, the item name consists of the word "cartridge"

followed by its caliber. The additional item identification consists of the word "electric" if the cartridge contains an electric primer, type of projectile, model number, and any further description necessary to completely identify the item. This description should include the words "steel case" if the cartridge case is steel, fuze nomenclature if the cartridge is fuzed, and the word "linked" if the cartridges are packed in cartridge links. The nomenclature for blank and dummy ammunition for aircraft guns differs from that for the other types of projectiles in that the type of projectile is inserted immediately before, instead of after, the colon and thus forms part of the item name. The use of item names approved by the Cataloging Division of the Office of the Director of Cataloging, Standardization, and Inspection is mandatory. Standard nomenclature should be used for all purposes of record. Ammunition items are listed alphabetically and numerically, grouped by caliber or weapon, in Department of the Army supply manuals and Department of the Air Force stock lists.

6. Federal Stock Number and Department of Defense Identification Code

The Federal stock number has replaced the Ammunition Identification Code (AIC) and item stock number. There is a different Federal stock number for each item of supply as packed. The first four positions in a Federal stock number are always the class in which the item belongs. The next seven positions in the Federal stock number are called the Federal Item Identification Number (FIIN). The dash between the third and fourth position in the FIIN is to reduce errors in transmitting. There is a different FIIN for each item in a Department of the Army supply manual and United States Air Force stock list. Thus, the Federal stock number is composed of the Class (first four positions) and the FIIN (next seven positions). In addition to the Federal stock number, a Department of Defense Identification Code for interchangeability of ammunition and explosive supplies consisting of four positions, a letter and three digits, has been added as a suffix to the Federal stock number. This code groups items together which are completely interchangeable as to function and use. Wherever the same code is used as a suffix to two or more Federal stock numbers, the items are interchangeable for issue and use.

7. Grade of Ammunition

a. Ammunition for 20-mm aircraft guns is not graded; all accepted lots thereof are serviceable for issue and use in all applicable weapons.

b. Due to the varying characteristics of the several types of caliber .50 weapons, applicability of immediate action, and the location of the gunner relative to the weapon, caliber .50 ammunition is classified as either grade AC or grade MG for purposes of identification, issue, and use. Caliber .50

ammunition lots indicating minimum or no probabilities of misfires or other malfunctions which may cause stoppages in remote weapons is classified as grade AC for use in aircraft and antiaircraft machine guns. All other ammunition lots within allowable specification limits are classified as grade MG for use in ground machine guns under the immediate, direct control of the gunner.

8. Propellants in Ammunition

The components in the propelling charge train are an electric primer or a percussion primer and a propelling charge. The firing pin ignites the primer by means of impact or electrical impulse and the flame passes through the vent leading to the propellent chamber and ignites the propelling charge; the expansion of the resultant gases forces the bullet or projectile out through the bore of the weapon.

9. Identification

a. General. Ammunition is identified completely, except as to grade, by packing and marking including the ammunition lot number, on original packing containers. Applicable grade of the caliber .50 ammunition lot is indicated by the Federal stock number. Linked cartridges for 20-mm gun M3 or M24A1 require that packing containers be marked to indicate right hand or left hand feed. When removed from its original packing containers, the full identity of the ammunition, including the lot number, nomenclature, and model designation, should be noted on issue slips, temporary containers, or by means of tags attached to ammunition belts.

b. Model. To identify a particular design, a model designation is assigned at the time the model is classified as an adopted type. This model designation becomes an essential part of the item name and is included in the marking of the item. Model designation consists of the letter M followed by an Arabic numeral, for example, M1. Modifications are indicated by adding the letter A and the appropriate Arabic numeral. Thus, M1A1 indicates the first modification of an item for which the original model designation was M1. Wherever the letter B, followed by an Arabic number, appears in a model designation, it indicates an item of alternative (or substitute) design, material, or manufacture. A design which has not been classified as an adopted type, but which may have been accepted for limited procurement, has a model designation consisting of the letter T followed by an Arabic numeral. A design modification which has not been standardized is indicated by the addition of the letter E and the appropriate Arabic numeral.

c. Ammunition Lot Number. When ammunition is manufactured, an ammunition lot number is assigned in accordance with pertinent specifications. As an essential part of the marking, this lot number is stamped or marked on the item, size permitting, as well as on all packing containers. It is required for all purposes of record, including reports on condition,

functioning, and accidents in which the ammunition is involved. To provide for the most uniform functioning, all of the components in any one lot are manufactured under as nearly identical conditions as practicable.

d. Painting and Marking.

(1) *Painting.* Ammunition is painted primarily to prevent rust. Secondary purposes are to provide, by the color, a ready means of identification and, by the use of lusterless paint, for camouflage. Ammunition for caliber .50 machine guns does not require painting. However, the bullet tips of cartridges are painted a distinctive color to aid in identifying cartridges as to type. Ammunition for 20-mm guns may be identified as to type by the color of the projectile. Refer to Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300 for detailed information on identification of 20-mm and caliber .50 ammunition. Distinctive colors used to identify types of cartridges covered in this manual are listed in table I.

(2) *Marking.* There is no marking on the bullet for caliber .50 ammunition. The manufacturer's initials and year of manufacture is stamped in the metal on the base of the cartridge case for all caliber .50 ammunition. Caliber and type of weapon in which fired, e.g., "20 G" or "20 MM" for, 20-mm gun, type and model of cartridge are stenciled on the projectile for 20-mm ammunition. The stenciling may include the ammunition lot number. In addition, the rotating band is stamped with the ammunition lot number, year of loading, and caliber and model number of the cartridge. ELEC is stenciled on the base of the cartridge case of cartridges for the 20-mm gun M24A1 to indicate the presence of an electric primer. Inert projectiles, such as those used in target practice and also all items listed in supply manuals as standard for issue, are suitably identified when marked INERT, EMPTY, or DUMMY, as appropriate. Other inert or empty components or rounds will be identified by drilled holes in addition to the impressed marking INERT, EMPTY, DRILL, or DUMMY. When the size of the item permits, the holes will be four in number, not smaller than ¼ inch in diameter, and drilled through the item 90 degrees apart. When components are deemed to be too small for the impressed markings, holes of lesser number and smaller diameter are required. The correct marking for items in which all explosives and incendiary materials are simulated by inert materials, is INERT. The correct marking for items from which the explosives and incendiary materials have been removed, is EMPTY. Items manufactured with all explosives and incendiary materials omitted require the marking EMPTY, DRILL, or DUMMY, as appropriate.

Table I. Color Identification of Cartridges for Aircraft Guns

Caliber .50 cartridges

Color of tip of bullet	Type of cartridge
Black	Armor-piercing
Aluminum color	Armor-piercing-incendiary, M8
Blue with aluminum color annulus to the rear.	Armor-piercing-incendiary, T49
Red with aluminum color annulus to the rear.	Armor-piercing-incendiary-tracer, M20
None	Ball
None (4 holes in cartridge case)	Dummy
None (tinned cartridge case)	High-pressure test
Light blue	Incendiary, M1
Blue with light blue annulus to the rear	Incendiary, M23
Red	Tracer, M1 and headlight tracer, M21
Orange	Tracer, M10
Brown	Tracer, M17

20-mm cartridges

Color of projectile	Color of marking	Type of cartridge
Black	White	Armor-piercing, armor-piercing-tracer, ball, dummy, and target practice.
Black with light blue nose	White	Armor-piercing-incendiary
Olive-drab ogive and red body	Black	High-explosive-incendiary
Gray with light blue nose	Black	Incendiary

10. Care, Handling, and Preservation

Ammunition for aircraft guns is packed to withstand conditions ordinarily encountered in the field, moisture-resistant containers and suitable packing boxes or crates being used to provide the desired protection for shipment and storage. For precautions and instructions for the care, handling, and preservation of ammunition for 20-mm and caliber .50 aircraft guns, refer to TM 9–1903/TO 11A–1–37.

11. Storage Precautions

Ammunition for aircraft guns consists of metals, which are subject to corrosion, and chemical agents and explosives, which are subject to decomposition during storage. In order to preserve the ammunition during storage most effectively, the precautions given in TM 9–1903/ TO 11A–1–37 should be observed.

12. Packing and Marking

a. In general, caliber .50 ammunition is either bulk packed in 10-round cartons or functionally packed in metallic belt cartridge links in either watertight metal liners or hermetically sealed cans in wooden boxes or in self-sealing caliber .50 metal boxes in wirebound wooden boxes. Twenty-millimeter ammunition is bulk packed in cartons in metal-lined wooden boxes or in hermetically sealed metal cans in wooden boxes or self-sealing metal boxes; it is also functionally packed in disintegrating belt cartridge links in hermetically sealed metal cans in wooden boxes or self-sealing metal boxes. For purposes of ready issue and use, ammunition for aircraft guns is functionally packed in cartridge links, either as individual types or in several ratios of two or more types. As an example, a caliber .50 functional lot may be belted in the ratio of four caliber .50 API, M8 cartridges to one caliber .50 API-T, M20 cartridge. For convenience in identification and record keeping, such caliber .50 lots are identified by functional (repacked) lot numbers; component lots thereof are marked on the outer packing box or on a reference card within the packing box. For detailed information on packing caliber .50 and 20-mm ammunition, refer to Department of the Army Supply Manual 9–5–1305/ United States Air Force Stock List 1300.

b. Each outer shipping container and all inner containers are fully marked to identify the ammunition contained therein. These markings include the descriptive nomenclature, including the word LINKED if the cartridges are packed in cartridge links, ammunition lot number, and the number of rounds. In addition to the above, the outer shipping container also is marked with the Federal stock number, Department of Defense Identification Code, Interstate Commerce Commission shipping name, average weight, cube, and ordnance insignia. Metal boxes are painted olive drab and marked in yellow. Some wooden boxes are stained light brown and marked in yellow. Those of current manufacture are

unstained and marked in black. The wooden box M23 is a typical packing box which is used for both caliber .50 cartridges (fig. 1) and 20-mm cartridges (fig. 2). Packing for ammunition for the 20-mm gun M39 series is differentiated from that for the 20-mm gun M61 by marking the model number of the applicable cartridge link on the outer packing container. A space is left blank in front of the word LINKS which appears on the side of the container. Model number T61E3 is inserted in the blank space if the ammunition in the box is for the gun M39 series. If the ammunition is for the gun M61, model number T76 is inserted in the blank space.

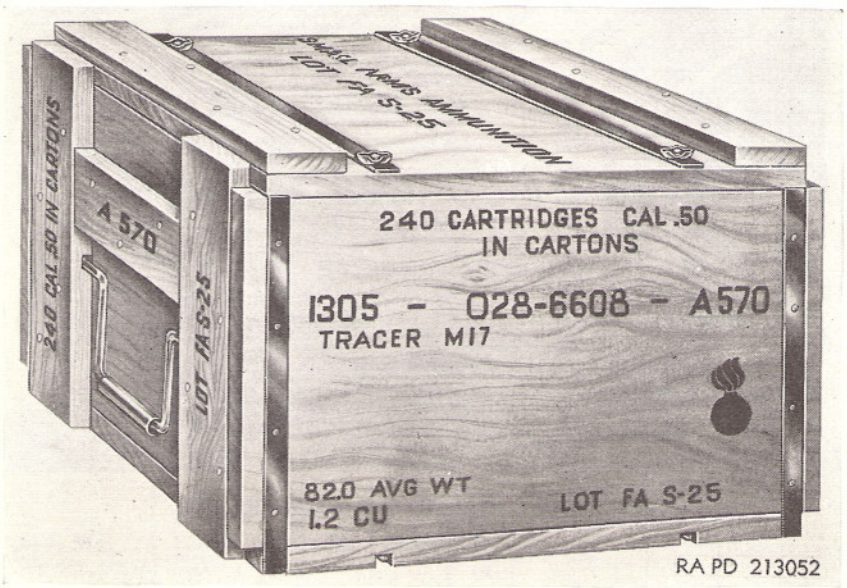

Figure 1. Caliber .50 ammunition packing box M23.

13. Forms and Reports

a. Authorized Forms. The forms generally applicable to units operating this materiel are listed in the appendix. For a listing of all forms, refer to DA Pam 310–2. For instructions on use of these forms, refer to FM 9–10.

b. Field Reports of Accidents. If an accident or malfunction involving the use of ammunition occurs during training or combat, the range officer for a unit in training or the officer or noncommissioned officer in charge of the firing unit in combat immediately will discontinue firing ammunition of the lot which malfunctions. He then will report the occurrence and all pertinent facts of the accidents or malfunction to the technical service officer under whose supervision the ammunition for the unit involved is

maintained or issued, in order that the action prescribed in AR 385–63/ AFR 50–13, SR 385–10–40 (AFR 136–9), and SR 700–45–6 may be taken. It is particularly helpful if the evidence of a malfunction round or rounds, for instance cartridges, weapons, fuzes, etc., can be preserved for study by designated ordnance laboratories. If conditions of combat preclude immediate compliance, the action prescribed above will be taken as soon as practicable.

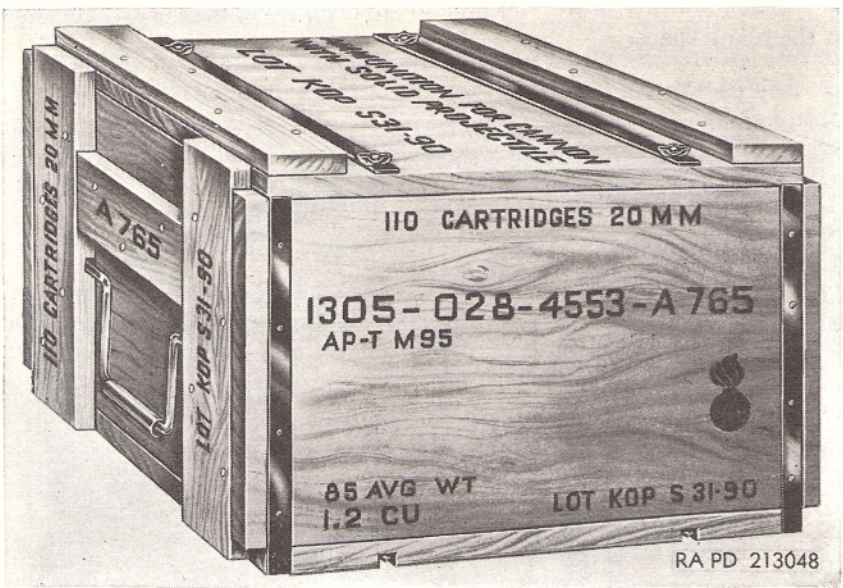

Figure 2. 20-MM Ammunition packing box M23.

CHAPTER 2

CARTRIDGES

Section I. CARTRIDGES FOR CALIBER .50 AIRCRAFT GUNS

14. General

a. General Discussion. A round of caliber .50 ammunition (fig. 3) consists of a bullet, a propelling charge, a primer, and a cartridge case, all assembled into a unit assembly (table II).

Table II. Weights of Caliber .50 Ammunition
(In grains; maxima permitted in manufacture)

Cartridge	Complete (approx.)	Cartridge case	Propelling charge (approx.)	Primer	Bullet				
					Complete	Jacket	Core (slug)	Point filler	Base filler
AP, M2	1,822 or 1,812[1]	850	235	19.06	718 or 708[1]	253	410 or 400[1]	56.5	----------
API, M8	1,739 or 1,726[1]	850	233	19.06	622 or 649[1]	-----	-----	-----	----------
API, T49	1,591	850	252	19.06	501	-----	-----	-----	----------
API–T, M20 (T28).	1,698 or 1,686[1]	850	230	19.06	624 or 612[1]	-----	-----	-----	Tracer and igniter Comp–14.
Ball, M33	1,768	850	237	19.06	661.5	253	400	56.5	----------
Incendiary, M1.	1,703	850	240	19.06	628.5	-----	-----	-----	----------
Incendiary, M23 (T48).	1,581	850	237	19.06	512	-----	-----	-----	----------
Tracer, M1:									
w/gilding metal jacket.	1,789	850	240	19.06	681	408	207	-----	Tracer and igniter Comp–70.
w/clad steel jacket.	1,750	850	240	19.06	641	368	207	-----	----------

See footnotes at end of table.

Table II. Weights of Caliber .50 Ammunition
(In grains; maxima permitted in manufacture)—continued

Cartridge	Complete (approx.)	Cartridge case	Propelling charge (approx.)	Primer	Bullet				
					Complete	Jacket	Core (slug)	Point filler	Base filler
Tracer, M10	1,750	850	240	19.06	641	368	207	------	Tracer and igniter Comp-70.
Tracer, M17 (T9).	1,742	850	225	19.06	648	368	207	------	Tracer and igniter Comp-77.
Tracer, headlight, M21 (T1E1):									
w/gilding-metal jacket.	1,779	850	240	19.06	704	408	207	------	Tracer and igniter Comp-93.
w/clad steel jacket.	1,739	850	240	19.06	664	368	207	------	----------
Blank, M1 (T40).	891	850	46	19.06	-----	-----	------	(Wad, 1.5)	----------
Dummy, M2:									
w/steel bullet.	1,214	850[2]	------	------	364	364	[3]	[3]	----------
w/gilding-metal bullet.	1,254	850[2]	------	------	404	404	[3]	[3]	----------
HPT, M1---	2,108	850	240	19.06	999	263	Front 325 Rear 411	------	----------

[1] Weight with alternative manganese-molybdenum steel core.
[2] Steel cartridge case which may be used weighs 750 grains.
[3] After 1 January 1943, no bullet core, slug, or filler was used in manufacture of dummy cartridges M2.

b. Bullet. Bullets for service use have a metal core or slug, which is covered with a gilding-metal or gilding-metal-clad steel jacket. Tracer bullets have a lead alloy core or slug, whereas all other bullet types have steel cores. Ball, M2; Ball, M33; Incendiary, M1 and some lots of Incendiary, M23 bullets have soft steel cores which are not intended for armor penetration; all armor-piercing type bullets have hardened steel alloy cores. Armor-piercing bullets have a point filler of antimony-lead between the jacket and the core. Ball M33 bullets have a point filler consisting of inert material such as sodium carbonate, monohydrate. Incendiary composition is the point filler for armor-piercing-incendiary, armor-piercing-incendiary-tracer, and incendiary bullets. Armor-piercing-incendiary-tracer and tracer bullets have a base filler of igniter and

tracer compositions in the base of the core. Armor-piercing-incendiary bullets have a base filler of lead. Bullets have a cylindrical or conically tapered base. The cylindrical base is called "square" and the tapered base is called "boattailed." A cannelure or annular knurled groove is rolled or cut into the jacket to provide a recess into which the cartridge case is crimped. A second cannelure or knurl may be present on some bullet types, such as the incendiary bullet, as a means of identification during manufacture.

c. Propellent Charge. Ammunition for aircraft guns of current manufacture may contain either single base (nitrocellulose) or double base (nitrocellulose-nitroglycerin) types of propellant. Caliber .50 ammunition of World War II production contained only single base propellent charges. Dependent upon the desired characteristics, each type of propellant may be of flake, tubular, spherical, or a modified spherical shape. Propellent charges for each cartridge type may vary slightly in daily production to counterbalance slight differences in burning characteristics and residual moisture content. Granulations of the propellant and weights of the cartridge charges are established in accordance with specification requirements of velocity and pressure for each type of cartridge. See paragraph 69 for more detailed information.

d. Primer. The primer consists of a brass or gilding-metal cup which contains a primer-composition pellet of sensitive explosive, a paper disk, and a brass anvil. See paragraph 74 for description of these primers.

e. Cartridge Case. The cartridge case is made of drawn brass. The cartridge case for the dummy cartridge M2 may be made of drawn steel. It serves as a means whereby the other components (primer, propelling charge, and bullet) are assembled into a unit, the cartridge. Another of its functions is to expand and seal the chamber against the escape of gases to the rear when the cartridge is fired. This action is known as obturation. To make the cartridge waterproof and to keep the propelling charge dry, the primer is sealed in the primer seat and the bullet is sealed in the neck of the cartridge case by a thin film of lacquer or varnish at the time of manufacture. An extractor groove, turned in the head of the cartridge case, provides a means of removing the case from the chamber of the weapon.

f. Identification.

(1) The type, caliber, model, and ammunition lot number, including the symbol of the manufacturer, are necessary for complete identification of caliber .50 ammunition.

(2) From the cartridge itself, the ammunition may be identified, except for lot number, by—

(*a*) The appearance of the cartridge and the color of the painted bullet tip (see fig. 4 and table I).

(*b*) The stamping on the base of the cartridge case. Because of its small size, the marking on small-arms ammunition is the

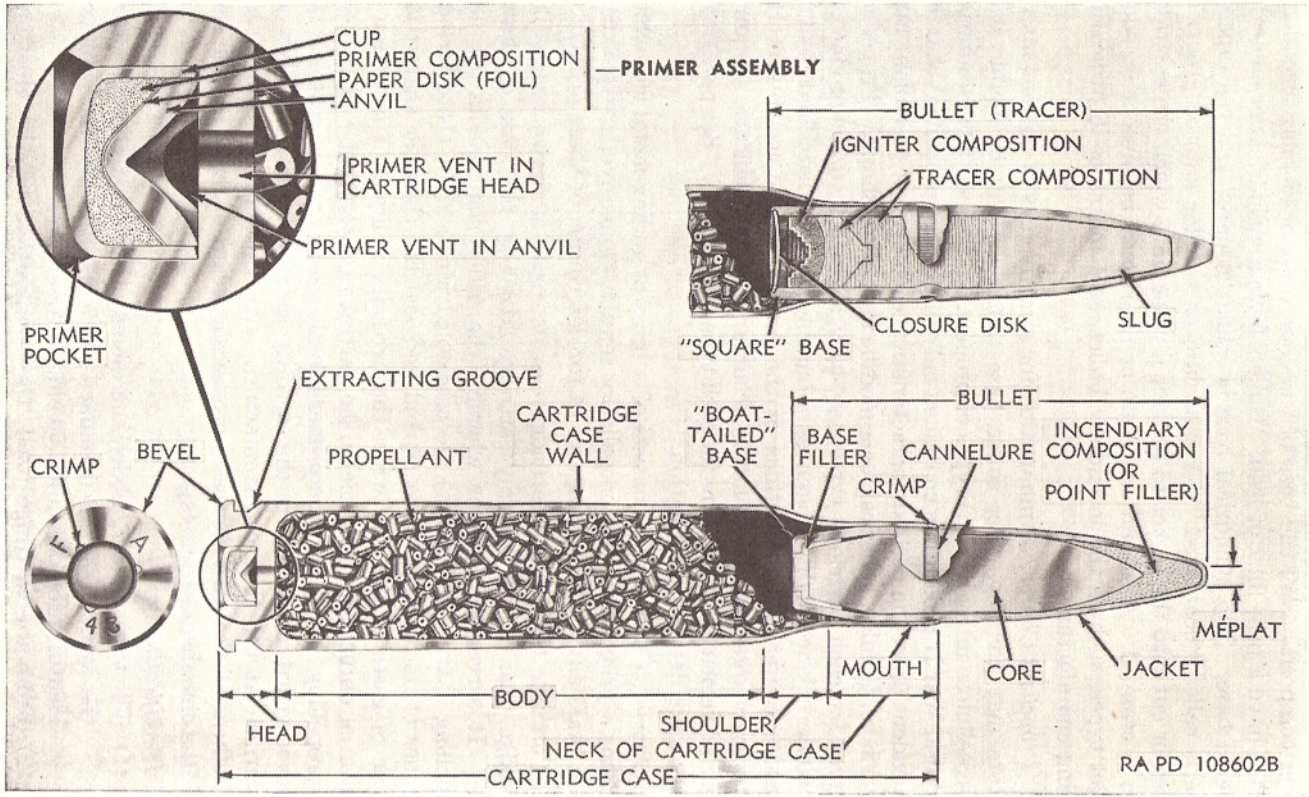

Figure 3. Cartridge terminology.

stamping of the manufacturer's initials and year of manufacture on the base of the cartridge case. For example, "FA 53" means the lot was loaded at Frankford Arsenal in 1953.

(3) From packings and containers, and markings thereon, the ammunition can generally be completely identified by—

(*a*) Markings on the original packing boxes and cartons.

(*b*) A functional reference data card inserted in each packing box containing functional lots of ammunition when component lots of the functional lot have not been marked on the outer packing box. Formerly, an identification card, usually 6½ x 15, was sealed inside the metal liner on top of ammunition in each box.

g. Packaging.

(1) The containers and methods for packing caliber .50 ammunition are given in the drawings, specifications, and Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300. Containers presently being manufactured have been designed to withstand all conditions commonly encountered in handling, storing, and transporting the ammunition.

(2) With few exceptions, caliber .50 ammunition is issued in metal containers packed for shipment in wooden boxes. There are two types of metal containers: Hermetically sealed can opened by means of a key and tear strip and metal boxes having hinged covers sealed by means of a rubber gasket.

(3) Packing materials used by Field Service for caliber .50 ammunition which are classed as containers, packaging, and packing supplies are listed in Department of the Army supply manuals and United States Air Force stock lists covering FCS group 81. These include boxes and cartons and certain box components. Box components which are classed as hardware, such as wingnuts and screwhooks, are listed in Department of the Army supply manuals and United States Air Force stock lists covering FCS group 53. Cartridge clips and cartridge links are classed as ammunition components and are listed in Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300.

15. Ballistics

The trajectories of caliber .50 service bullets, except those in the incendiary M23 and API T49 cartridges, for aircraft use match at 1,000 yards. The time of flight does not differ by more than 1/10 second under specified conditions. The bullets of incendiary M23 and API T49 cartridges are lighter than other service bullets weighing approximately 500 grains and have a muzzle velocity of 3,450 feet per second. They also have matched ballistics.

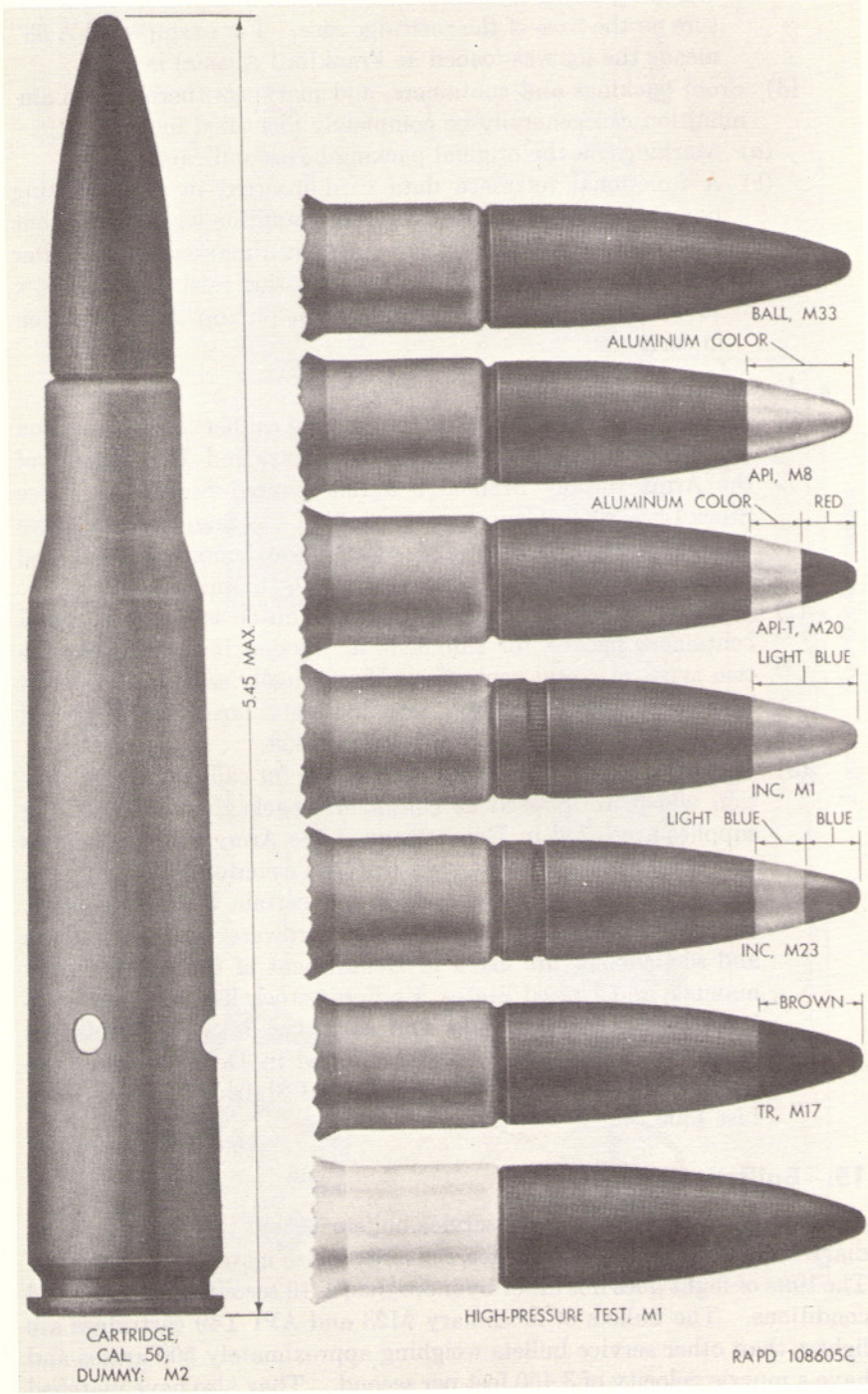

Figure 4. Caliber .50 cartridges.

16. Cartridge, Caliber .50: Armor-Piercing, M2

a. Cartridge. This cartridge is designed for use against armored aircraft, armored vehicles, concrete shelters, and similar bullet-resisting targets. The cartridge is 5.45 inches long. It may be identified by the black bullet tip.

b. Bullet. The bullet consists of three parts: A gilding-metal jacket, a hardened core of tungsten-chrome or manganese molybdenum steel, and a point filler of an antimony-lead alloy. The overall length of the bullet is 2.31 inches. The base has a 9-degree taper beginning 0.386 inch from the base.

17. Cartridge, Caliber .50: Armor-Piercing-Incendiary, M8

a. Cartridge. This cartridge is a round for caliber .50 machine guns. It replaces the incendiary cartridge M1 and armor-piercing cartridge M2 for manufacture and issue. This cartridge is 5.45 inches long. It is identified by the aluminum color bullet tip.

b. Bullet. The bullet contains the same core as the armor-piercing bullet, caliber .50, M2, but the point filler is replaced by an incendiary composition and the bullet also contains a lead alloy base filler seal. The length of the bullet is 2.31 inches.

18. Cartridge, Caliber .50: Armor-Piercing-Incendiary, T49

a. Cartridge. This cartridge is for use only in caliber .50 aircraft machine guns. It has a higher velocity than the API cartridge, caliber .50, M8 and is intended for use with the incendiary cartridge, caliber .50, M23 (T48), since it has similar exterior ballistics. This cartridge is 5.45 inches in length. It may be identified by the bullet tip, which is painted medium blue with an aluminum color annulus to the rear.

b. Bullet. The bullet consists of three parts: A gilding-metal jacket, a hardened manganese-molybdenum steel core, and a point filler of an antimony-lead alloy. The bullet has a square base and is shorter, being 1.935 inches in length, than API bullet, caliber .50, M8.

19. Cartridge, Caliber .50: Armor-Piercing-Incendiary-Tracer, M20

a. Cartridge. This cartridge is for caliber .50 machine guns. It is similar to the armor-piercing-incendiary caliber .50, M8 cartridge, with the addition of a tracer element. As this bullet has its own tracer, the use of tracer cartridges for the production of traces is unnecessary in machine gun belts. The cartridge is 5.45 inches long. It is identified by the tip of the bullet, which is painted red with an aluminum annulus to its rear.

b. Bullet. The bullet is similar to the armor-piercing-incendiary bullet, caliber .50, M8, but it differs in having a trace. Visible trace begins at approximately 100 yards from muzzle and continues to at least 1,600 yards.

20. Cartridge, Caliber .50: Ball, M33

a. Cartridge. This cartridge was designed to replace the ball cartridge M2 as an item of issue and to duplicate ballistics of an inert caliber .50 API cartridge M8. It is designed for general use where tracer, incendiary, or armor penetration characteristics are not important considerations. The cartridge is 5.45 inches long and does not have any bullet point identification coloring. As its visual appearance is the same as the ball cartridge M2, this cartridge will be identified by markings on the packing containers. Headstamp markings are a further means of identifying ball M2 and ball M33 cartridges; the last lot of ball cartridges M2 was produced in 1950, whereas the first lot of ball cartridge M33 was manufactured in 1951.

b. Bullet. The bullet consists of three parts: A jacket of gilding metal or gilding metal clad steel, a soft steel core, and an inert point filler. The overall length of the bullet is (tapered) 2.31 inches. It has a boat-tailed base.

21. Cartridge, Caliber .50: Incendiary, M1

a. Cartridge. This cartridge is an item of issue for use in caliber .50 machine guns. The cartridge is 5.45 inches long. It may be identified by the bullet tip, which is painted light blue, and by a second, knurled cannelure rolled into the bullet jacket.

b. Bullet. The bullet consists of a gilding-metal jacket, a hollow, cylindrical, steel body, a lead-antimony base slug, and a core and point filler of incendiary composition. The bullet is 2.09 inches long and has a square (cylindrical) base.

22. Cartridge, Caliber .50: Incendiary, M23

a. Cartridge. This cartridge is an item of issue for use only in caliber .50 aircraft machine guns. It has a higher velocity than the incendiary cartridge M1 and is more effective as an incendiary against aviation kerosene. The cartridge is 5.45 inches long. It may be identified by the bullet tip, which is painted medium blue with a light blue annulus to the rear.

b. Bullet. The bullet is similar in external appearance to the incendiary bullet M1. The bullet M23 consists of a gilding-metal jacket, a clad steel container, a lead-antimony base slug, and an incendiary composition. The weight of incendiary composition is greater than that in the incendiary bullet M1. The bullet is 2.290 inches long and has a square (cylindrical) base.

23. Cartridge, Caliber .50: Tracer, M1

a. Cartridge. This cartridge is an item for observation of fire in caliber .50 machine guns. It is limited to use for training purposes only. It is replaced for combat use by the CARTRIDGE, CALIBER .50: tracer,

M17. Care must be exercised when using this cartridge to prevent it from igniting dry vegetation on the range. This cartridge is 5.45 inches long. It is identified by the tip of the bullet, which is painted red.

b. Bullet. The bullet consists of three parts: A gilding-metal or a gilding-metal clad steel jacket, an antimony-lead alloy slug, which fills the forward end of the jacket, and tracer and igniter compositions which fill the balance. Unlike the bullets for armor-piercing and ball cartridges, this bullet is cylindrical to the base which is open to permit the propelling charge to ignite the tracer composition. The overall length of the bullet is 2.40 inches. The trace begins at a distance not greater than 250 feet from the weapon; the range of the trace is about 1,600 to 1,800 yards.

24. Cartridge, Caliber .50: Tracer, M10

a. Cartridge. This cartridge is for observation of fire in all caliber .50 aircraft machine guns. It serves the same purposes as the tracer cartridge M1. The cartridge is 5.45 inches long. It may be identified by the bullet tip, which is painted orange.

b. Bullet. The description and exterior ballistics for the tracer bullet M1 with gilding-metal clad steel jacket are applicable to the tracer bullet M10, except that the M10 has a dim trace for the first 225 yards of flight followed by a bright trace to 1,600 to 1,900 yards.

25. Cartridge, Caliber .50: Tracer, M17

a. Cartridge. This cartridge can be used as a substitute for the API–T cartridge, caliber .50, M20 except that penetration is not so great. It replaces the tracer cartridge M1 for use in caliber .50 aircraft machine guns. The cartridge is 5.45 inches long. It may be identified by the bullet tip, which is painted brown. The tips of bullets manufactured prior to 1952 were painted maroon.

b. Bullet. The description and exterior ballistics for the tracer bullet M1 with gilding-metal clad steel jacket are applicable to the tracer bullet M17, except that the M17 has a bright trace to approximately 2,450 yards of flight. Trace begins at a point not greater than 250 yards from the weapon. Tracer cartridges M17 manufactured since 1950 contain a gilding-metal cup or a vinylite disk, designated as a bullet base closure seal, in the base of the bullet. This seal is intended to prevent chemical action between the bullet tracer composition and the residual moisture in the propellant and, accordingly, to prolong the shelf life of this cartridge.

26. Cartridge, Caliber .50: Tracer, Headlight, M21

a. Cartridge. This cartridge is for caliber .50 aircraft machine guns for use in combat against other aircraft. When viewed from the front, its trace, due to the use of certain igniter composition instead of tracer composition such as is used in tracer bullet M1, is three times as brilliant as the trace of the tracer bullet M1. The tracer M21 has some incendiary effect at 150 and 350 yards, but is negligible at 600 yards. The cartridge

is 5.45 inches long. It may be identified by the bullet tip, which is painted red.

b. Bullet. The description and exterior ballistics of the tracer bullet M1 are applicable to the tracer bullet M21, except that the M21 has a very bright trace to approximately 550 yards.

27. Cartridge, Caliber .50 Blank: M1

This blank cartridge is for use in aircraft caliber .50 machine guns when these weapons are fitted with blank firing attachments for training operations. The cartridge is 3.910 inches long. It is identified by the absence of the bullet. The cartridge case has a slight annular groove about ¼ inch from the mouth; this serves as the seat for the wad. The wad is a disk punched out of strawboard sheet 1/16 inch thick; it is lacquered on both sides before insertion into the mouth of the case. After loading, a heavy coat of vermillion lacquer is applied to the wad and the mouth is crimped.

28. Cartridge, Caliber .50 Dummy: M2

a. Cartridge. This cartridge is for use in all caliber .50 machine guns for training purposes. It may also be used for testing the mechanism of the gun. The cartridge is 5.45 inches long. Some cases of current manufacture may be of steel instead of brass.

b. Bullet. The dummy cartridge has a gilding-metal or gilding-metal clad steel jacket. The bullet is 2.40 inches long and has a square (cylindrical) base.

29. Cartridge, Caliber .50: Test, High-Pressure, M1

a. Cartridge. This cartridge is used for proof-firing of caliber .50 machine guns at the place of manufacture or rebuild. The cartridge is loaded with a propellent charge sufficient to develop a breech pressure from 60,000 to 65,000 p.s.i. Due to this excessive pressure and the danger involved in firing, the guns under test are fired from a fixed rest under a hood by means of a mechanical firing device. This cartridge should be fired only by authorized personnel. The cartridge is 5.45 inches long. It is distinguished from other caliber .50 cartridges by the tinned cartridge case.

b. Bullet. The bullet consists of a gilding-metal jacket and a core made up of two antimony-lead alloy slugs, a front slug and a rear slug. The length of the bullet is 2.42 inches. The bullet has a square base.

30. Cartridges With Deteriorated Tracer Elements

Armor-piercing-incendiary-tracer and tracer-types of caliber .50 cartridges with deteriorated tracer elements, as listed in Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300, may be substituted for ball ammunition for training requirements within the continental United States.

Section II. CARTRIDGES FOR 20-MM GUN M3

31. General

a. General Discussion. The 20-mm gun M3 is a link disintegrating, belt-fed (fig. 5), automatic aircraft cannon for use against aircraft and ground or sea-borne targets. At present, the M3 is the only 20-mm gun that fires percussion-primed ammunition. Percussion-primed ammunition manufactured in the United States, that is to be used jointly by the British, must be proof-fired in British guns to determine whether the lot develops sufficiently low chamber pressure for acceptance for firing in British weapons. If the ammunition is accepted by both United States and British services, the words COMMON AMM are marked or printed on the packing boxes. All ammunition for this gun is issued in the form of fixed complete rounds known as "cartridges." The shape, length, and weight of these cartridges are approximately the same. The trajectories of the projectiles cross at 1,000 yards, at which range the time of flight for each projectile is approximately 1.66 seconds when fired from a stationary weapon with a muzzle velocity of 2,730 feet per second.

Warning: Electric-primed ammunition CANNOT be fired in the gun M3.

b. Identification. The color scheme for the painting and marking of these cartridges for purposes of identification is indicated in table I (par. 9). It should be noted that painting and marking of the high-explosive-incendiary and incendiary cartridges differ from the basic color scheme prescribed in TM 9–1900/TO 11A–1–20, but all essential information is provided.

c. Projectile. Dependent upon type of projectile, ammunition for this gun is classified as high-explosive-incendiary (HEI), armor-piercing with tracer (AP–T), incendiary, target-practice (TP), or dummy.

d. Fuze. The PD fuze M505 (T196E4) is used with the HEI cartridges, replacing the PD fuze M75 which may be found on cartridges of earlier manufacture. Both of these fuzes are single-action, impact-type, percussion fuzes. The PD fuze M505 is relatively boresafe. See paragraphs 65 and 66 for description of these fuzes.

e. Cartridge Case. The cartridge cases M21A1 (brass) and M21A1B1 (steel) are used with these cartridges. The weight of the cartridge case M21A1 is 0.214 pound; the cartridge case M21A1B1 is approximately 0.025 pound lighter and has a deeper extracting groove machined in the head. A single vent is provided in both cartridge cases.

f. Propelling Charge. The cartridge contains 0.07 pound of single-base (nitrocellulose) propellant. See paragraph 69 for more detailed information.

g. Primer. The percussion primer M36A1, containing a 2.1-grain charge of primer mixture, is used with these cartridges. See paragraph 70 for description of this primer.

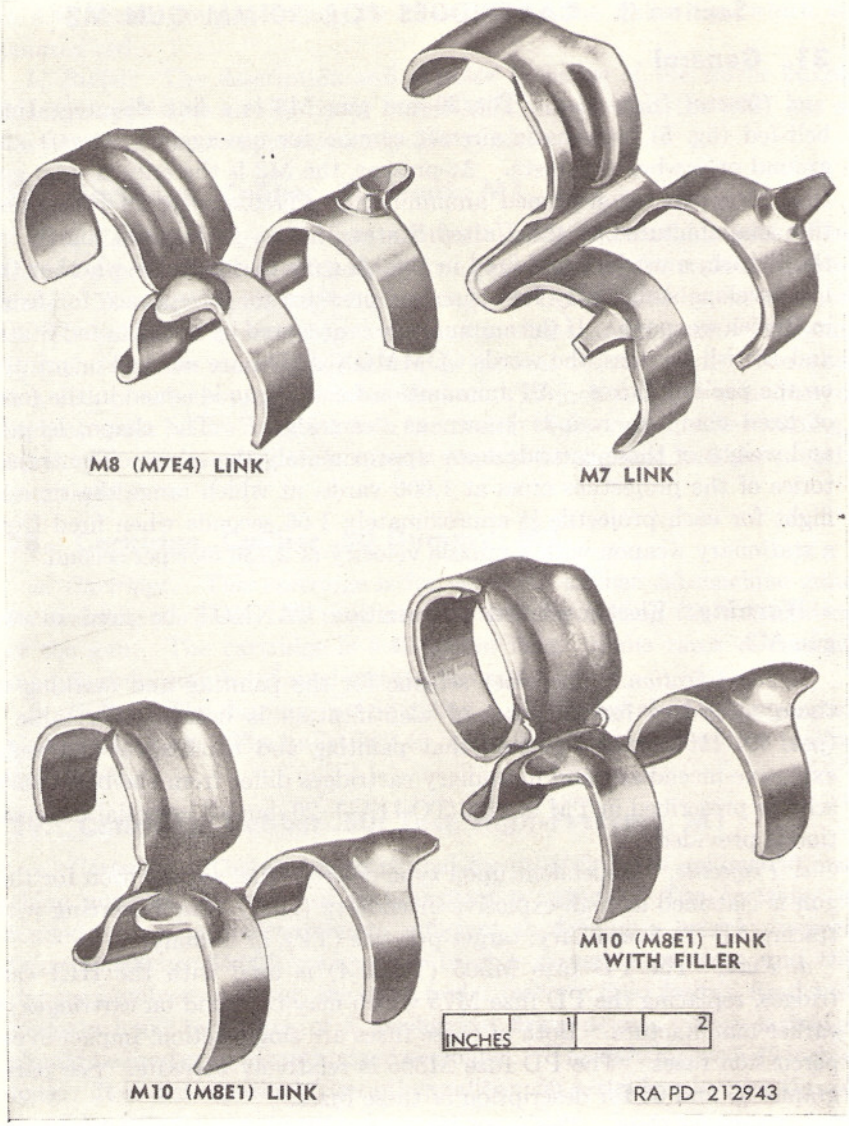

Figure 5. Cartridge links and cartridge link filler for ammunition for 20-mm gun M3.

h. Disintegrating Belt Cartridge Links. These links and filler (fig. 5) are considered as ammunition components. They are listed in Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300. Metallic belt link M7, M8, or M10 (M8E1) can be used to make up belts for either right or left hand 20-mm feed mechanism M3 or AN–M2; however, only one type of link may be used in the same belt. Their nomenclature and piece marks are as follows:

LINK FILLER, CARTRIDGE: 20-mm A7305535
LINK, CARTRIDGE: disintegrating belt, 20-mm, M10 (M8E1) 7238242
LINK, CARTRIDGE: disintegrating belt, 20-mm, M8 7230430
LINK, CARTRIDGE, disintegrating belt, 20-mm M7 7225949

The link M8 is an improvement in design over the link M7. The link M10 (M8E1) differs from the link M8 in finish, heat treatment, and contour design. It can be distinguished from the M8 by the comparatively greater taper on the outside of the single loop. This increases flexibility of the belt and prevents holdups in the ammunition chute. A cartridge link filler (fig. 5) is used with the link M10 (M8E1) when it is desired to load belts for double-loop left hand feed.

i. Packing and Shipping Data. Cartridges for 20-mm gun M3 are contained in both bulk and functional-type packing. Primary bulk packs vary from 10 rounds in a cardboard carton to 55 rounds per steel can; these containers are overpacked (in varying quantities) into metal cans or wooden boxes for shipment and storage. Functional packings are made up of one type, more than one type, or several types, or ratio pack of cartridges in a 40-round link belt which is packed into metal can M21, and overpacked (in varying quantities) into either metal cans or wooden boxes. The belts are either linked for right hand feed or linked for left hand feed. For additional information on packing of 20-mm ammunition, see Department of the Army Supply Manual 9–5–1305/ United States Air Force Stock List 1300.

32. Cartridge, 20 Millimeter: AP-T, M95

a. General. This cartridge (fig. 6) is for use against armored targets. The projectile is a solid shot made from bar or forged steel. A drawn steel windshield is crimped into annular grooves in the projectile body, the portion of the windshield over the crimping acting as the bourrelet of the projectile. The base of the projectile contains a red tracer composition, sealed in by means of a metal closing cup. The tracer burns for about 2.25 seconds, equivalent to a range of about 1,400 yards. Minimum burning time of tracer is 2.0 seconds, equivalent to a range of 1,270 yards.

b. Data.

Weight of complete round	0.57 lb.
Length of complete round	7.23 in.
Length of projectile	3.27 in.
Length of cartridge case	4.34 in.
Width of rotating band	0.203 in.
Type of base	square
Radius of ogive	2.3 cal.
Muzzle velocity	2,730 fps.
Maximum range	5,900 yd.

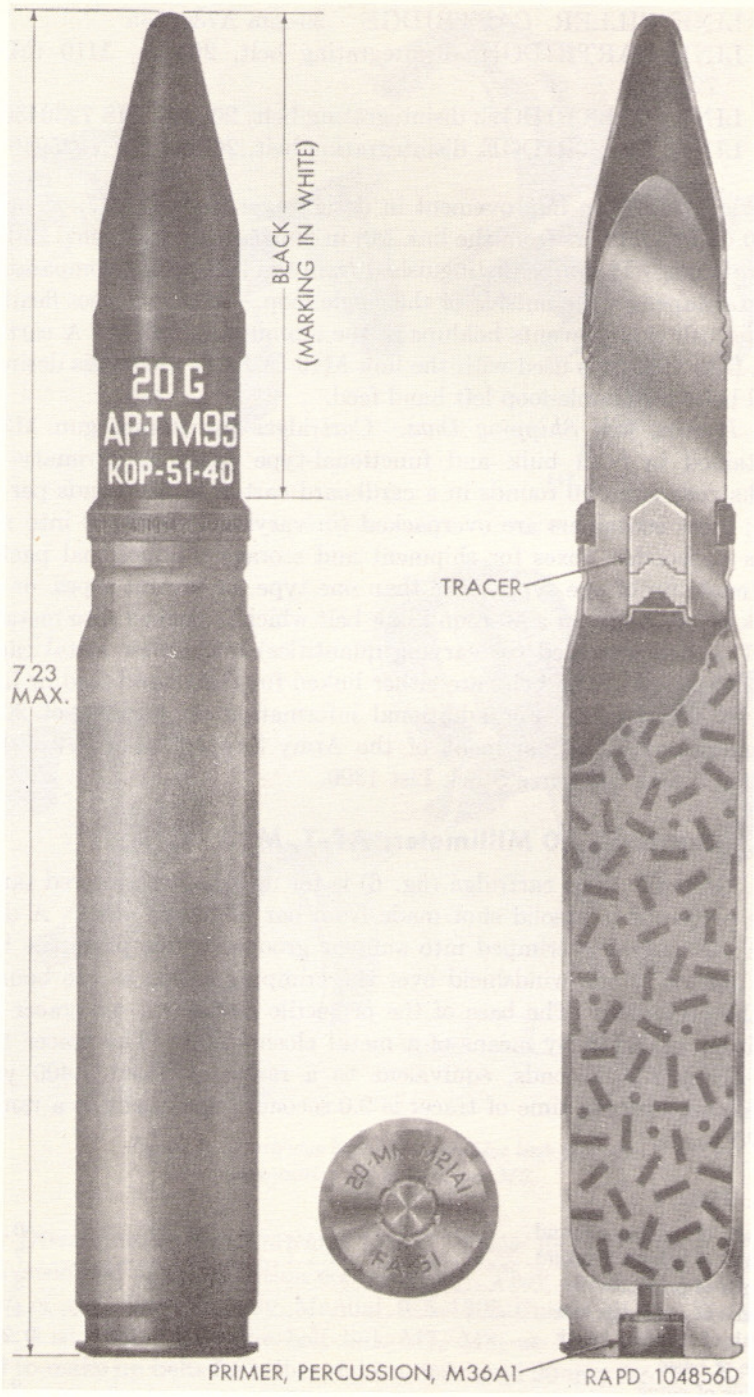

Figure 6. Cartridge, 20 millimeter: AP-T, M95.

33. Cartridge, 20 Millimeter: AP-T, M95, Steel Case

This cartridge is the same as the item in paragraph 32, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

34. Cartridge, 20 Millimeter: HEI, M58 (T241), W/Fuze, PD, M505

a. General. This cartridge (fig. 7), which replaces the M97A1, differs from the M97A1 (par. 36) principally in the interior design and loading of the projectile. It provides an adequate ballistic match with the M97A1. The M58 is an improvement over the M97A1 in blast, fragmentation, and incendiary effect. The weight of the incendiary charge (MOX–2B) is 0.026 pound. The weight of explosive is 0.03 pound, composed of 0.026 pound of MOX–2B and 0.004 pound of RDX. Upon impact, the charge is functioned with a combined detonative and incendiary effect. A base cover is welded to the base of the projectile for additional safety. The PD fuze M505 is an instantaneous percussion fuze of the impact-type. See paragraph 66 for description of this fuze.

b. Data.

Weight of complete round	0.55 lb.
Length of complete round	7.25 in. (max.)
Length of fuzed projectile	3.31 in.
Length of cartridge case	4.34 in.
Type of base	square

35. Cartridge, 20 Millimeter: HEI, M97, W/Fuze, PD, M75

This cartridge, which is replaced by the M97A1, differs from the M97A1 (par. 36) principally in the fuze. The fuze M75, which is described in paragraph 65, has no interrupter or other special devices for boresafety. In this respect, it differs from the fuze M505.

36. Cartridge, 20 Millimeter: HEI, M97A1, W/Fuze, PD, M505

a. General. This cartridge is for use against aircraft and light materiel targets, functioning with both explosive and incendiary effect. The high-explosive is tetryl and is located in the nose portion of the projectile, while the incendiary mixture is located in the base. The combined weight of the high-explosive-incendiary filler is 0.017 pound composed of 0.005 pound of incendiary mixture and 0.012 pound of tetryl. Upon impact, its filler is detonated, the shell shattered, and the incendiary composition ignited. Its fuze is an instantaneous percussion fuze of the impact-type. The thickness of the base is approximately 0.2 inch, and a base cover is welded thereon for additional protection.

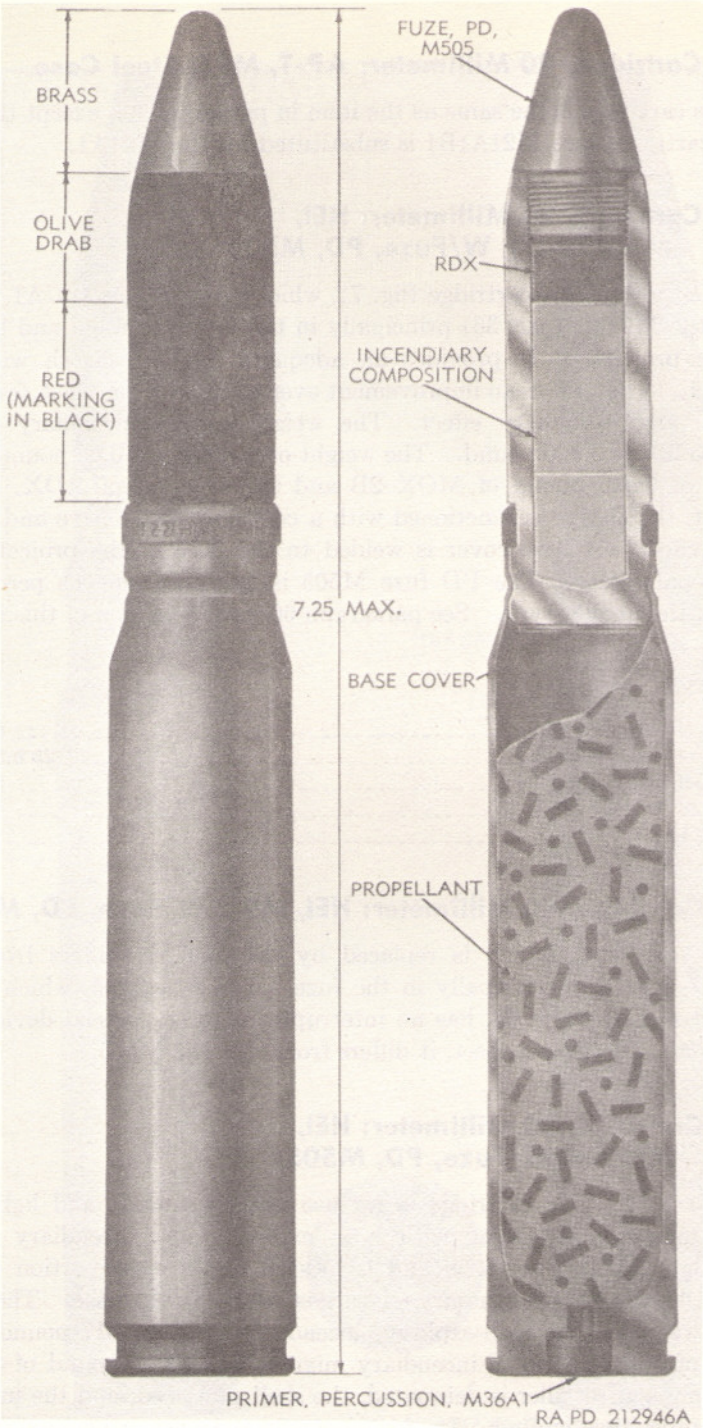

Figure 7. Cartridge, 20 millimeter: HEI, M58 (T241), w/fuze, PD, M505.

b. Data.

Weight of complete round	0.57 lb.
Length of complete round	7.23 in.
Length of fuzed projectile	3.28 in.
Length of cartridge case	4.34 in.
Width of rotating band	0.203 in.
Type of base	square
Radius of ogive	2.55 cal. (to 0.7 dia., then conical ogive)
Muzzle velocity	2,730 fps.
Maximum range	5,750 yd.

37. Cartridge, 20 Millimeter: HEI, M97A1, Steel Case, W/Fuze, PD, M505

This cartridge is the same as the item in paragraph 36, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

38. Cartridge, 20 Millimeter: Incendiary, M96

a. General. This cartridge is for use against aircraft, functioning with incendiary effect. The body of the projectile is made of cold-drawn steel. The nose, threaded to screw into the body, is made of a die-cast zinc alloy; it is painted light blue for identification. Both the body and nose are filled with incendiary composition. This projectile does not require a fuze, as functioning is initiated by impact of nose upon target.

b. Data.

Weight of complete round	0.55 lb.
Length of complete round	7.18 in.
Length of projectile	3.23 in.
Length of cartridge case	4.34 in.
Width of rotating band	0.203 in.
Type of base	square
Radius of ogive	2.55 cal. (to 0.7 dia., then conical ogive)
Muzzle velocity	2.730 fps.
Maximum range	5,700 yd.

39. Cartridge, 20 Millimeter: Incendiary, M96, Steel Case

This cartridge is the same as the item in paragraph 38, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

40. Cartridge, 20 Millimeter, Dummy: M18A3

This cartridge is a completely inert assembly, which is intended to provide a cartridge for drill purposes and for testing the feed mechanism of the weapon. The service projectile and cartridge case are simulated by a one-piece zinc- or cadmium-coated casing made of steel, cold-drawn to size, shape, and weight of the service round. A steel base plug, formed to provide an extractor groove like that on service ammunition, is soldered into the recessed base. Some rounds of earlier manufacture have a

threaded base and base plug. Alternative manufacturing designs for this drill cartridge have a steel body plug secured in the nose of the cartridge. Weight is 0.57 pound; length is 7.22 (max.) inches.

41. Cartridge, 20 Millimeter: TP, M99

a. General. This cartridge (fig. 8) is for practice firing. The projectile is similar in shape and ballistic properties to the incendiary shell M96 but is hollow and contains no explosive. The nose consists of a zinc-die casting as in the M96 incendiary but its weight is adjusted to give the projectile a weight of 2,000 grains (0.29 lb.). The projectile body is made of cold-drawn steel.

b. Data.

Weight of complete round	0.57 lb.
Length of complete round	7.23 in.
Length of projectile	3.27 in.
Length of cartridge case	4.34 in.
Width of rotating band	0.203 in.
Type of base	square
Radius of ogive	2.54 cal. (to 0.7 dia., then conical ogive)
Muzzle velocity	2,730 fps.
Maximum range	5,750 yd.

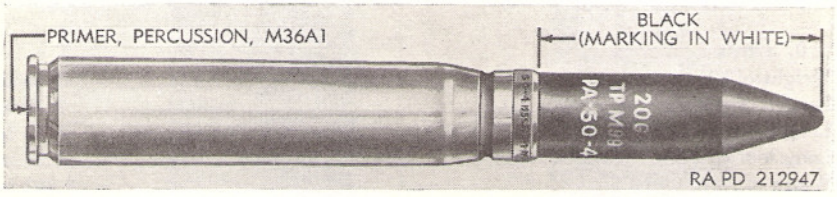

Figure 8. Cartridge, 20 millimeter; TP, M99.

Section III. CARTRIDGES FOR 20-MM GUN M24A1

42. General

a. General Discussion. The 20-mm gun M24A1 is an automatic aircraft cannon for use against aircraft and ground or sea-borne targets. It is a combination blowback and gas-operated, air-cooled, belt-fed gun. It can be adapted for belt feeding from either the right or left hand side. The gun is designed to fire electric-primed ammunition only. All ammunition for this gun is issued in the form of fixed complete rounds. The cartridges are linked into disintegrating belts by use of cartridge link M10 (*h* below). The cartridges for this gun are the same as those fired in the 20-mm gun M3, except that the electric primer M52A3 replaces the percussion primer M36A1. Although the model designations are the same for both the electric-primed and percussion-primed cartridges, in the

nomenclature of the former, the word "electric" is inserted before the type designation. The trajectories of the projectiles cross at 1,000 yards, at which range the time of flight for each projectile is approximately 1.66 seconds when fired from a stationary weapon with a muzzle velocity of 2,730 feet per second.

Warning: Percussion-primed ammunition CANNOT be fired in the M24A1 gun.

b. Identification. Painting and marking of these cartridges for purposes of identification is the same as that of cartridges for the 20-mm gun M3, except for the designation ELEC, which is stenciled on the head of the cartridge case with black ink. Some rounds of earlier manufacture have a purple annulus about the primer at the head of the cartridge case, caused by the dye in the waterproofing compound that was used.

c. Projectile. Dependent upon the type of projectile, ammunition for these guns is classified as high-explosive-incendiary (HEI), armor-piercing with tracer (AP-T), armor-piercing (AP) (with or without tracer cavity plug), incendiary, target-practice (TP), or dummy.

d. Fuze. The PD fuze M505 (T196E4) is used with the HEI cartridges; HEI cartridges fuzed with the PD fuze M75 are no longer issued. The PD fuze M505 is a single-action, impact-type, percussion fuze which is relatively boresafe. See paragraph 66 for a description of this fuze.

e. Cartridge Case. The cartridge cases M21A1 (brass) and M21A1B1 (steel), used with these cartridges, are identical with those used with cartridges for the 20-mm gun M3 (par. 31*e*).

f. Propelling Charge. The cartridges contain the same propelling charge as the ammunition for the 20-mm gun M3. See paragraph 69 for more detailed information.

g. Primer. The electric primer M52A3, containing a 2.75 (max.) grain charge of primer mixture is used with these cartridges. The electric primer M52A2, which differs from the M52A3 in the primer charge, may be found assembled to cartridges of earlier manufacture. The insulator of the primer M52A2 is colored black, while that of the M52A3 is red. See paragraph 71 for description of the primer M52A3.

h. Disintegrating Belt Cartridge Links. Belts for 20-mm feed mechanism M2E5 or M2E7 of the gun M24A1 are made up of cartridge link M10 (M8E1). The feed mechanism M2E5 and the feed mechanism M2E7 consist of two distinct feed mechanisms for each model—a right hand feed mechanism and a left hand feed mechanism. Although the same cartridge link is used to form belts for right hand feed and belts for left hand feed, the method of loading the belts is different. Belts for either right or left hand feed may also be loaded with single-loop leading or with double-loop leading. For double-loop leading, a cartridge filler link is used to close the single loop at the end of the belt. For methods of loading the four types of belts, see TM 9–2024. For complete nomen-

clature, piece mark, and brief description of the link and filler, see paragraph 31*h*.

i. Packing and Shipping Data. Cartridges for 20-mm gun M24A1 are contained in the same types of bulk and functional packing as those described for the cartridges used in 20-mm gun M3 (par. 31*i*). For additional information on packing of 20-mm ammunition, see Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300.

43. Cartridge, 20 Millimeter: Electric, AP, M95, W/Tracer Cavity Plugged

This cartridge (fig. 9) is identical with the item in paragraph 44, except that the tracer composition is omitted and the tracer cavity is closed by a plug.

44. Cartridge, 20 Millimeter: Electric, AP-T, M95

This cartridge is identical with the cartridge described in paragraph 32, except that the electric primer M52A3 replaces the percussion primer M36A1.

45. Cartridge, 20 Millimeter: Electric, HEI, M58 (T241), W/Fuze, PD, M505

This cartridge is identical with the cartridge described in paragraph 34, except that the electric primer M52A3 replaces the percussion primer M36A1.

46. Cartridge, 20 Millimeter: Electric, HEI, M97A1, W/Fuze, PD, M505

This cartridge is identical with the cartridge described in paragraph 36, except that the electric primer M52A3 replaces the percussion primer M36A1.

47. Cartridge, 20 Millimeter: Electric, HEI, M97A1, Steel Case, W/Fuze, PD, M505

This cartridge is identical with the item in paragraph 46, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

48. Cartridge, 20 Millimeter: Electric, Incendiary, M96

This cartridge is identical with the cartridge described in paragraph 38, except that the electric primer M52A3 replaces the percussion primer M36A1.

49. Cartridge, 20 Millimeter: Electric, Incendiary, M96, Steel Case

This cartridge is identical with the item in paragraph 48, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

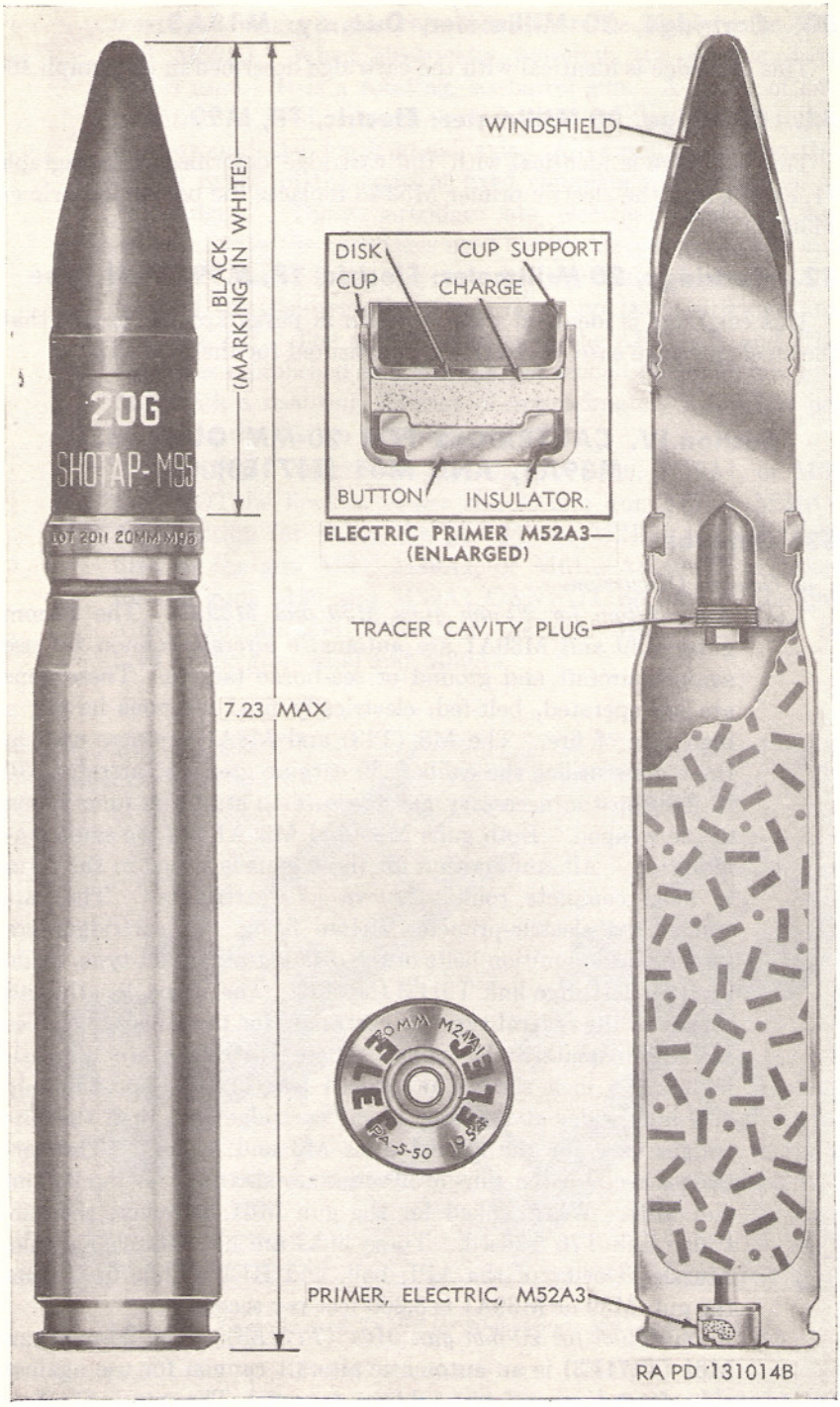

Figure 9. Cartridge, 20 millimeter: electric, AP, M95, w/tracer cavity plugged.

50. Cartridge, 20 Millimeter, Dummy: M18A3

This cartridge is identical with the cartridge described in paragraph 40.

51. Cartridge, 20 Millimeter: Electric, TP, M99

This cartridge is identical with the cartridge described in paragraph 41, except that the electric primer M52A3 replaces the percussion primer M36A1.

52. Cartridge, 20 Millimeter: Electric, TP, M99, Steel Case

This cartridge is identical with the item in paragraph 51, except that the steel cartridge case M21A1B1 is substituted for the M21A1.

Section IV. CARTRIDGES FOR 20-MM GUNS M39, M39A1, AND M61 (T171E3)

53. General

a. General Discussion.

(1) *Ammunition for 20-mm guns M39 and M39A1.* The 20-mm guns M39 and M39A1 are automatic aircraft cannon for use against aircraft and ground or sea-borne targets. These guns are gas-operated, belt-fed, electrically fired weapons having a high rate of fire. The M8 (T13) and M8A1 chargers used in these guns utilize the caliber .30 carbine grenade cartridge M6 to develop the necessary gas pressure to start the functioning of the weapon. Both guns M39 and M39A1 fire the same ammunition. All ammunition for these guns is issued in the form of fixed complete rounds known as "cartridges." The cartridges are electric-primed. Before firing, the cartridges are loaded in ammunition belts of the disintegrating belt type, made up from cartridge link T61E3 (fig. 10). The shape, length, and weight of the several types of cartridges for the guns M39 series are approximately the same. These cartridges are approximately 0.6 inch shorter in overall length and approximately 0.19 inch wider at the base of the cartridge case than the cartridges used for the 20-mm guns M3 and M24A1. The cartridges used for the guns M39 series are also used for the 20-mm gun M61. When linked for the gun M61, however, the cartridge link T76 is used. These links are not interchangeable. Muzzle velocity of the API, ball, and HEI rounds fired from the gun M39 or M39A1 is 3,300 feet per second.

(2) *Ammunition for 20-mm gun M61 (T171E3).* The 20-mm gun M61 (T171E3) is an automatic aircraft cannon for use against aircraft and ground or sea-borne targets. The gun is an electrically or hydraulically powered, belt-fed, electrically fired

weapon having a higher rate of fire than the 20-mm guns M39 and M39A1. When electrically powered, the electric drive M7 is used. It is a rotating, six-barrel gun. A round of ammunition is fired through each barrel, as the barrels rotate *once* around the longitudinal axis. All ammunition for this gun is issued in the form of fixed complete rounds known as "cartridges." These cartridges are electric-primed and are identical with the cartridges used for the 20-mm guns M39 and M39A1. Before firing, the cartridges are loaded in ammunition belts of the disintegrating type, made up from cartridge link T76 (fig. 11). The muzzle velocity of the API, ball, and HEI rounds is established at 3,300 feet per second in the 20-mm gun M39 with a resulting velocity of approximately 3,430 feet per second in the 20-mm gun M61.

Warning: Ammunition for the gun M39, M39A1, or M61 CANNOT be fired in either the 20-mm gun M3 or M24A1. Ammunition for either the gun M3 or M24A1 CANNOT be fired in the gun M39, M39A1, or M61. Ammunition linked for the guns M39 and M39A1 CANNOT be fired in the gun M61. Ammunition linked for the gun M61 CANNOT be fired in the guns M39 and M39A1.

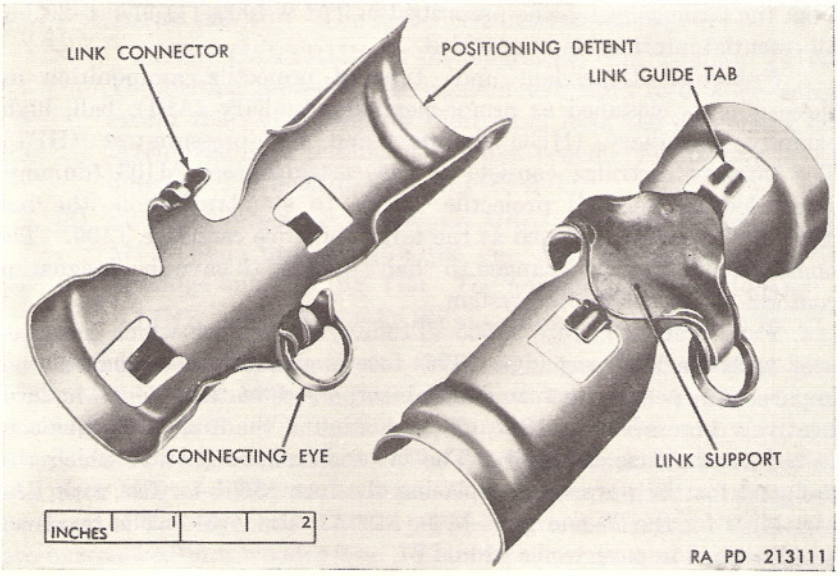

Figure 10. Cartridge link T61E3 for 20-mm guns M39 and M39A1.

b. Identification. The color scheme for the painting and marking of these cartridges for purposes of identification is indicated in table I (par.

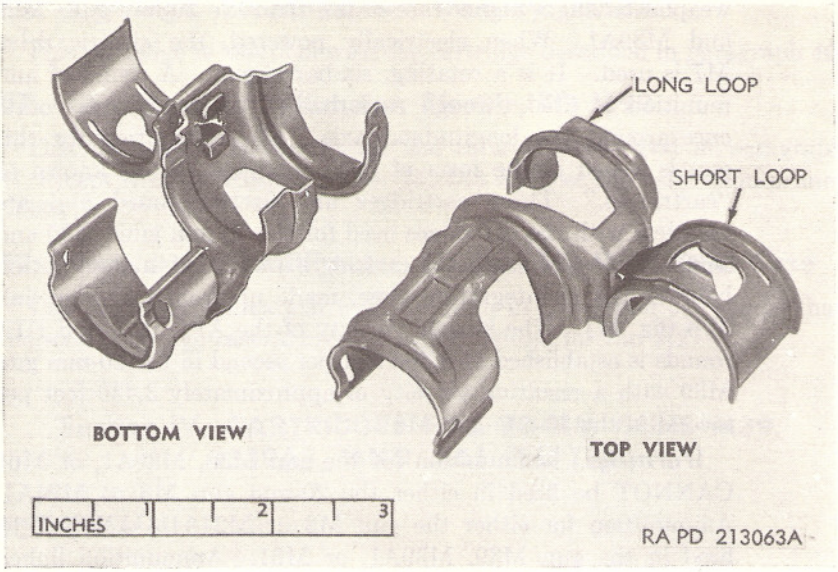

Figure 11. Cartridge link T76 for 20-mm gun M61.

9). It should be noted that painting and marking of the armor-piercing-incendiary, high-explosive-incendiary, and incendiary cartridges differ from the basic color scheme prescribed in TM 9–1900/TO 11A–1–20, but all essential information is provided.

c. Projectile. Dependent upon type of projectile, ammunition for these guns is classified as armor-piercing-incendiary (API), ball, high-explosive-incendiary (HEI) dummy, and high-pressure-test (HPT). The dummy cartridge consists of the cartridge case M103 (dummy) assembled to the ball projectile. Prior to standardization, the ball cartridge M55 was designed as the target practice cartridge T199. The nomenclature has been changed to "ball" in order to have the designation conform to the small-arms system.

d. Fuze. The PD fuze M505 (T196E4) is the fuze which has been used with the HEI cartridge. This fuze is classified as a single-action, impact-type, percussion fuze and it incorporates features which make it relatively boresafe. In 1957, all production of the fuze M505 was converted to the fuze M505E1. The latter is a modification which was designed for the purpose of replacing the fuze M505 for use with HEI cartridges for the 20-mm guns M39, M39A1, and M61. The two fuzes are described in paragraphs 66 and 67.

e. Cartridge Case. Cartridge cases M103 (brass), M103B1 (steel), and M103 (dummy) (brass) are used as components of these cartridges. The weight of the cartridge case M103 is 0.26 pound approximately. The weight of the cartridge case M103B is 0.25 pound approximately. The cartridge case M103 (dummy), which is used only with the dummy

cartridge, weighs approximately the same as the cartridge case M103. A single vent is provided in the cartridge cases M103 and M103B1. In more recent production using the primer M52A3B1, a cellulose case vent seal is used to seal the vent before the primer is inserted. The cartridge case M103 (dummy) has no primer recess or vent.

f. Propelling Charge. The cartridge cases contain 0.08 pound approximately of single-base (nitrocellulose) or of double-base (nitrocellulose-nitroglycerin) propellant of the modified spherical type commonly referred to as Western Ball propellant. See paragraph 69 for more detailed information.

g. Primer. The electric primer M52A3B1 is used with the service cartridges. The electric primer M52A3 or the M52A5 is used with the HPT cartridge. See paragraphs 71 through 73 for more detailed information.

h. Disintegrating Belt Cartridge Links.

(1) *General.* Cartridge links for the 20-mm aircraft guns are considered as ammunition components and shall be listed in Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300.

(2) *For ammunition for 20-mm guns M39 and M39A1.* Belts for either the right or left hand feeder assemblies utilized for either the gun M39 or M39A1 are made up of the cartridge link T61E3 (fig. 10). The nomenclature is as follows:

LINK, CARTRIDGE: disintegrating belt, 20-mm, T61E3.

The belting procedure for right or left hand feed is the same, except that, in belting for right hand feed, the connecting eye is removed from the link of the first round. For belting procedure, see TM 9–2310/TO 11W1–12–3–11.

(3) *For ammunition for 20-mm gun M61.* Belts for the gun feeder M1 (T8E1) utilized with the gun M61 are made up of the cartridge link T76 (fig. 11). The nomenclature is as follows:

LINK, CARTRIDGE: disintegrating belt, 20-mm, T76.

i. Packing and Shipping Data. The cartridges for the 20-mm guns M39, M39A1, and M61 are packed in both bulk and functional-type packing. The primary bulk pack is 50 rounds in a can with two cans overpacked into a wooden box. The functional pack of cartridges for the guns M39 and M39A1 contains 28 rounds in a disintegrating belt made up of cartridge links T61E3, packed into a metal can. These cans are overpacked in a wooden box. The functional pack of cartridges for the gun M61 contains 27 rounds in a disintegrating belt made up of cartridge links T76, packed into a metal can. These cans are overpacked in a wooden box. Packing and shipping data appear in Department of the Army Supply Manual 9–5–1305/United States Air Force Stock List 1300. Packing and marking for shipment is described in paragraph 12.

54. Cartridge, 20 Millimeter: Electric, Armor-Piercing-Incendiary, T221E3

a. General. This cartridge is for use against armored targets, functioning with a combined incendiary and penetration effect. The body of the projectile is solid shot made from bar alloy steel. The nose, which is made of aluminum alloy, is charged with three separately pressed increments of incendiary composition weighing a total of 80 grains. The nose is sealed with a closure disk. A steel adapter is crimped into the annular grooves in the projectile body; the adapter receives the base portion of the nose and is crimped so as to allow the conical base of the closure disk to seat on the tip of the projectile body. This cartridge does not require a fuze, as functioning is initiated by impact of nose upon target. The cartridge case M103 and the electric primer M52A3B1 are used in this cartridge. A cellulose case vent seal is assembled in the primer recess between the vent and the primer.

b. Data.

Weight of complete round	0.57 lb.
Weight of projectile, as fired	0.22 lb.
Length of complete round	6.615 in. (max.)
Length of projectile	2.98 in.
Length of cartridge case	4.015 in.
Width of rotating band	0.203 in.
Type of base	square

55. Cartridge, 20 Millimeter: Electric, Armor-Piercing-Incendiary, T221E3, Steel Case

This cartridge is identical with the cartridge described in paragraph 54, except that this round is assembled with the cartridge case M103B1 (steel) instead of the cartridge case M103 (brass). The steel cartridge case is approximately 0.01 pound lighter than the brass case.

56. Cartridge, 20 Millimeter: Electric, Ball, M55

This cartridge is replaced by the cartridge M55A1 (pars. 57 and 58) for use in practice firing. The projectile of this cartridge is used in the 20-mm dummy cartridge M51 (par. 62). The cartridge was developed as the target practice cartridge T199; upon being standardized, the designation was changed to "ball." The projectile of this cartridge differs from the projectile of the cartridge M55A1 of current manufacture (par. 57) in material, inner contour, and rotating band seat. The body is steel but of a different composition than that of the body in the M55A1. The cavity in the body is in the form of a cylinder as shown in figure 14. The shape of the rotating band seat and the design of the nose, which is secured to the body by swaging, do not insure that the metal parts are as securely fastened together as in the current cartridge M55A1. In some projectiles for the cartridge M55, the nose may be screwed to the body. The cartridge case M103 and the electric primer M52A3 are used in the cartridge M55.

57. Cartridge, 20 Millimeter: Electric, Ball, M55A1

a. General. This cartridge (fig. 12) is for use in practice firing; prior to standardization of the basic model, this type of cartridge was referred to as a target practice (TP) cartridge. The nomenclature has been changed to "ball" in order to have the designation conform to the small-arms system. The projectile of this cartridge consists of body, nose, and rotating band. The body is made of steel; it is hollow and contains no filler. The nose, which may be assembled to the body with screw threads and a thermosetting resin or keyed to the body by swaging, is made of aluminum alloy and is solid. The cartridge M55A1 of current production, which replaces the cartridges M55 and M55A1 of earlier design, incorporates several improvements in the design of the projectile. These include better steel for the body, a modified (double-undercut) rotating band seat, and metal parts more securely fastened together. The cartridge case M103 loaded with approximately 0.084 pound of double-base (Western Ball) propellant and the electric primer M52A3B1 are used in the cartridge M55A1. A cellulose case vent seal is assembled in the primer recess, between vent and primer. Early production of the cartridge M55A1 may contain the electric primer M52A3 and no case vent seal and the propellant may be single-base (nitrocellulose).

b. Data.

Weight of complete round	0.56 lb.
Weight of projectile, as fired	0.22 lb.
Length of complete round	6.615 in. (max.)
Length of projectile	2.98 in.
Length of cartridge case	4.015 in.
Width of rotating band	0.203 in.
Type of base	square

58. Cartridge, 20 Millimeter: Electric, Ball, M55A1, Steel Case

This cartridge is identical with the cartridge described in paragraph 56, except that this round is assembled with the cartridge case M103B1 (steel) instead of the cartridge case M103 (brass). The steel cartridge case is approximately 0.01 pound lighter than the brass case.

59. Cartridge, 20 Millimeter: Electric, HEI, M56 (T198), W/Fuze, PD, M505

This cartridge is replaced by the cartridge M56A1 (pars. 60 and 61) for use for detonative and incendiary effect against aircraft and light materiel targets. The projectile of this cartridge differs from the projectile of the cartridge M56A1 in material of the body, rotating band seat, and method of attaching the base cover to the projectile body. The steel from which the body is made is a different composition from that of the M56A1 body, the rotating band seat is not double-undercut, and the base cover is welded to the base. The cartridge case M103 and the electric primer M52A3 are used in the cartridge M56.

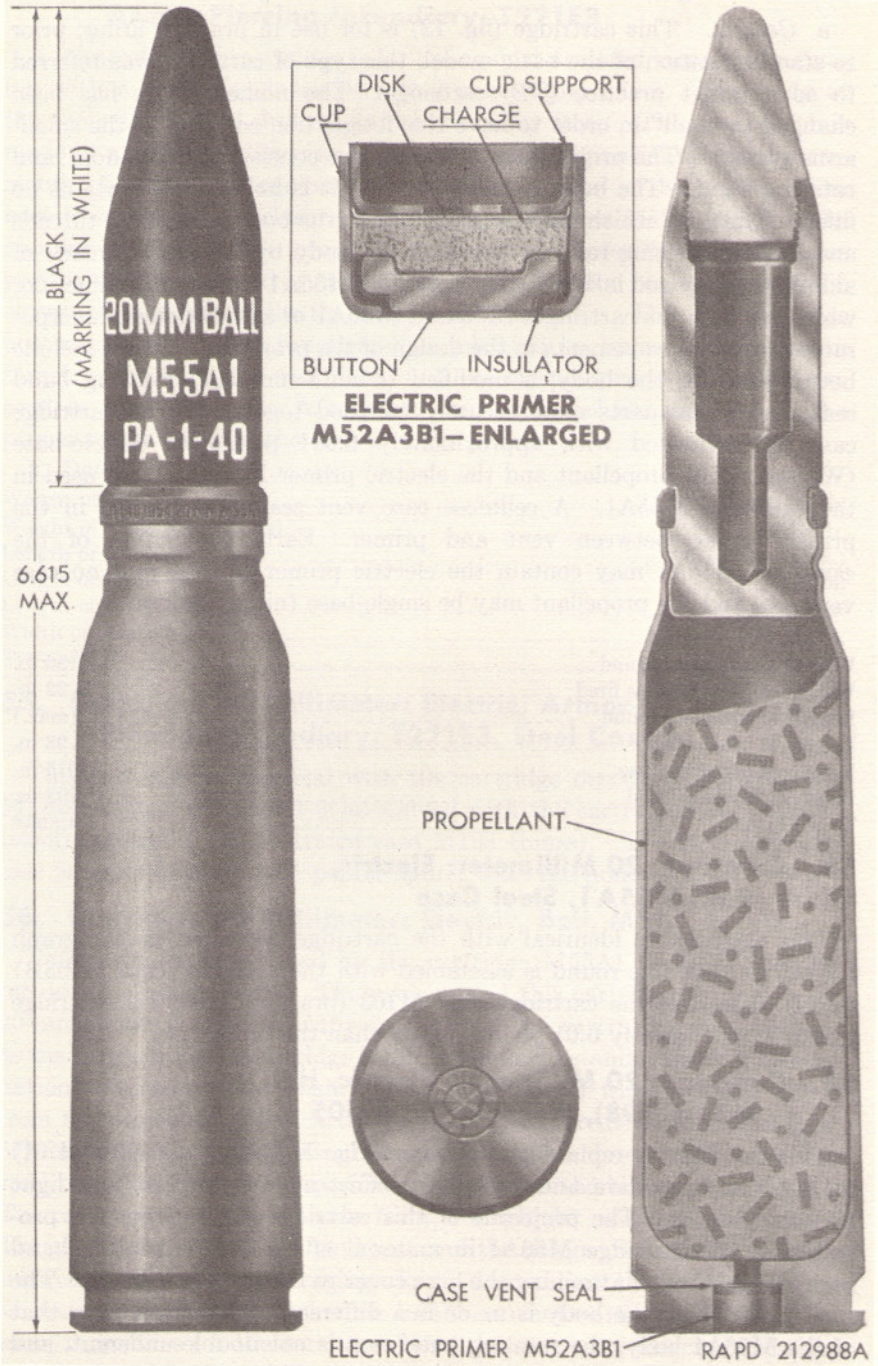

Figure 12. Cartridge, 20 millimeter: electric, ball, M55A1.

60. Cartridge, 20 Millimeter: Electric, HEI, M56A1 (T198E1), W/Fuze, PD, M505

a. General. This cartridge (fig. 13) is for use against aircraft and light materiel targets, functioning with both detonative and incendiary effect. The projectile body is a steel, relatively thin-walled casing. The weight of the incendiary composition, which is MOX–2B, is 0.26 pound. The total weight of explosive is 0.03 pound, composed of 0.026-pound MOX–2B and 0.004-pound RDX. The RDX explosive is loaded between the base of the fuze and the incendiary composition which occupies the rest of the interior of the projectile body. The thickness of the base of the projectile is approximately 0.21 inch and the base cover is crimped thereon for additional safety. Upon impact, the charge is functioned with a combined detonative and incendiary effect. Functioning is initiated by the PD fuze M505, an instantaneous fuze of the impact type, which is described in paragraph 66. The PD fuze M505E1 which is described in paragraph 67 may be used instead of the fuze M505. The cartridge case M103, loaded with approximately 0.083 pound of double base (Western Ball) propellant, and the electric primer M52A3B1 are used in the cartridge M56A1. A cellulose case vent seal is assembled in the primer recess, between vent and primer.

b. Data.

Weight of complete round	0.56 lb.
Weight of projectile, as fired	0.22 lb.
Length of complete round	6.615 in. (max.)
Length of fuzed projectile	3.025 in.
Length of cartridge case	4.015 in.
Width of rotating band	0.203 in.
Type of base	square

61. Cartridge, 20 Millimeter: Electric, HEI, M56A1, Steel Case, W/Fuze, PD, M505

This cartridge is identical with the cartridge described in paragraph 60, except that this round is assembled with the cartridge case M103B1 (steel) instead of the cartridge case M103 (brass). The steel cartridge case is approximately 0.01 pound lighter than the brass case.

62. Cartridge, 20 Millimeter, Dummy: M51 (T228)

a. General. This cartridge (fig. 14) is a completely inert assembly that is used for drill purposes and for testing the feeder assembly of the weapon. The service cartridge is simulated by assembling the projectile of the ball cartridge M55 (par. 56) or M55A1 (par. 57) with the cartridge case M103 (dummy). The cartridge case contains approximately 0.086 pound of inert material in order to produce an average overall weight equal to that of the service cartridges.

b. Data.

Weight of complete round	0.56 lb.
Length of complete round	6.615 in. (max.)
Length of cartridge case	4.015 in.

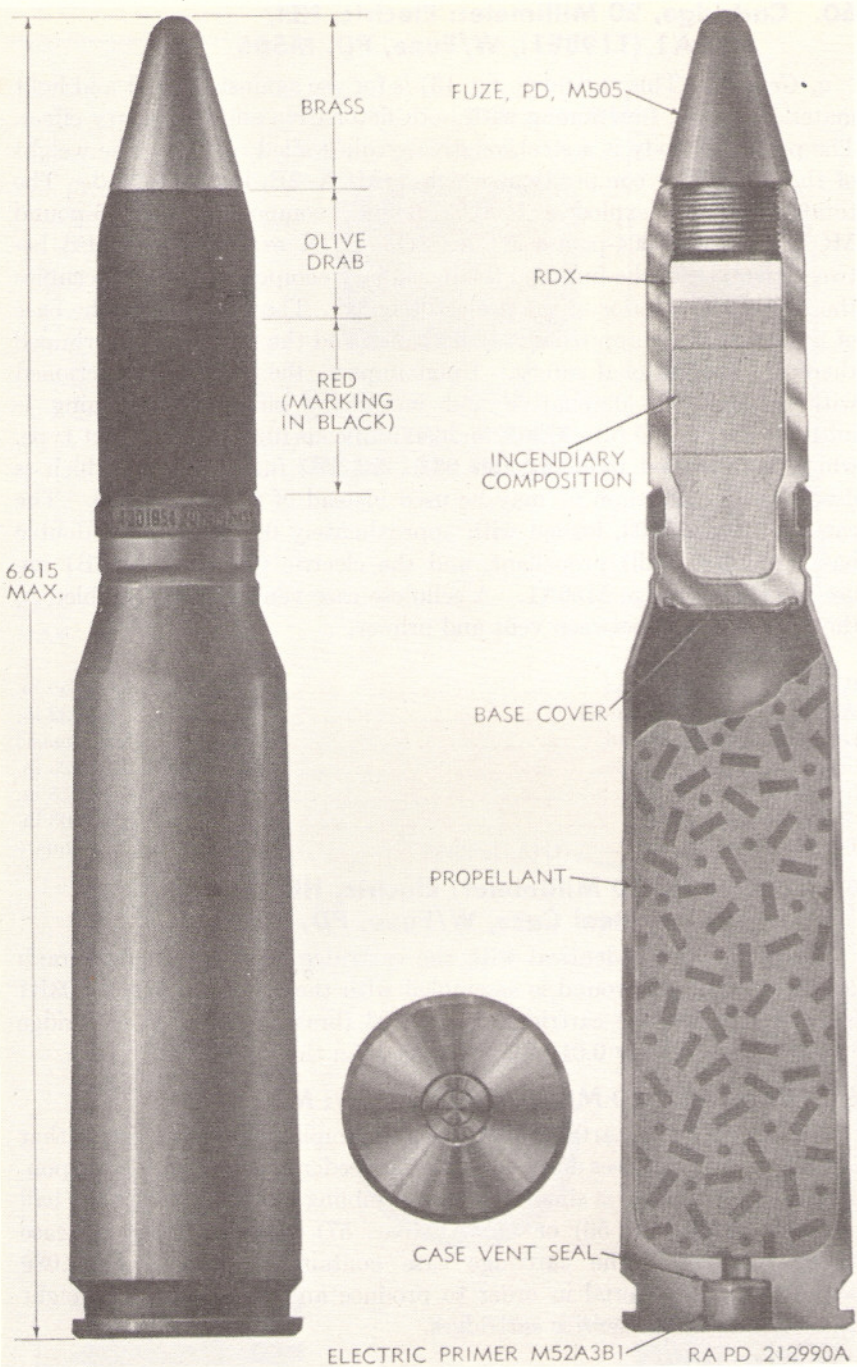

Figure 13. Cartridge, 20 millimeter: electric, HEI, M56A1 (T198E1), w/fuze, PD, M505.

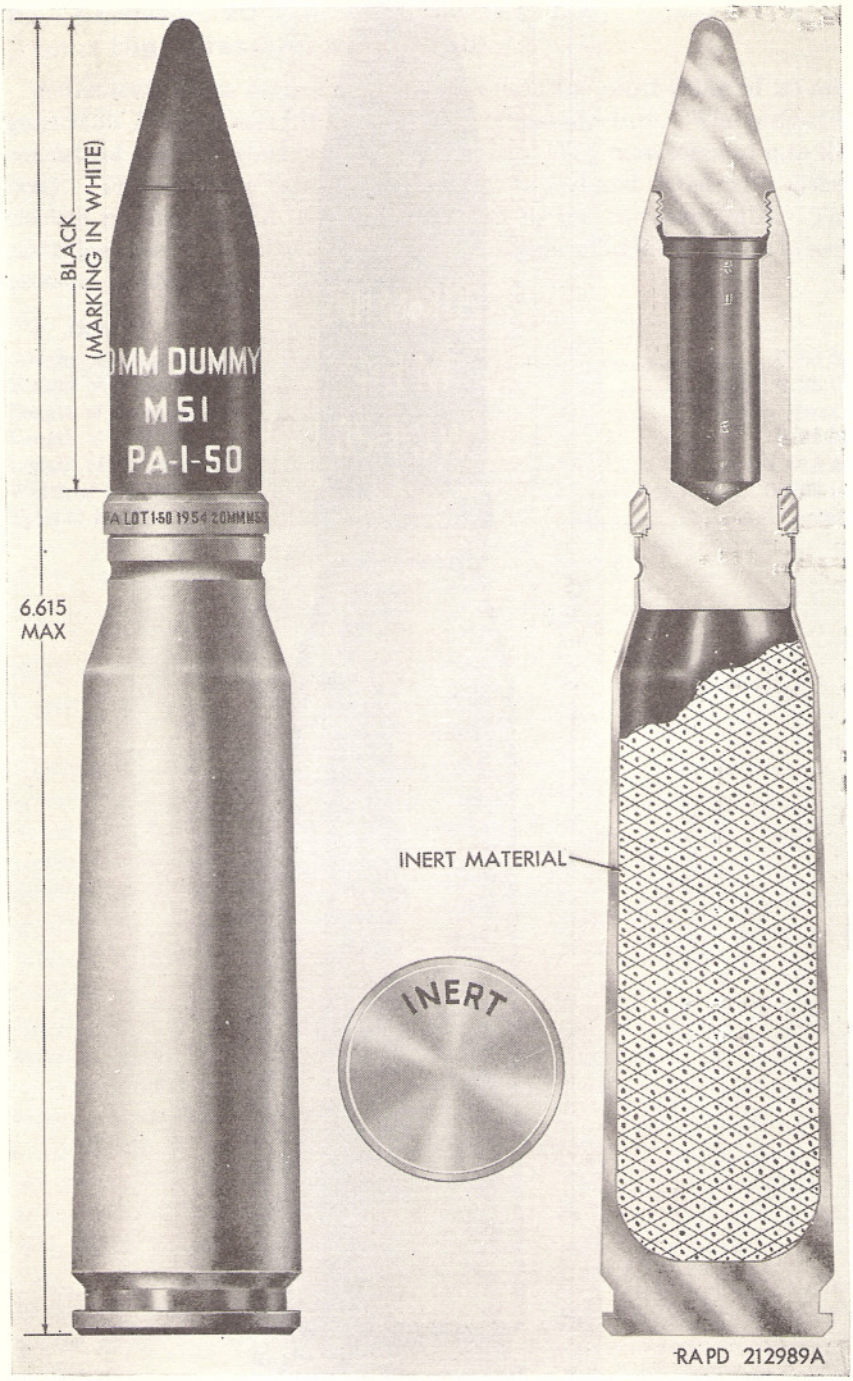

Figure 14. Cartridge, 20 millimeter, dummy: M51 (T228).

Figure 15. Cartridge, 20 millimeter: electric, test, high-pressure, M54 (T156).

63. Cartridge, 20 Millimeter: Electric, Test, High-Pressure, M54 (T156)

a. General. This cartridge (fig. 15) is used for proof-firing of 20-mm guns M39, M39A1, and M61 at the place of manufacture. The projectile consists of a hollow steel body and a zinc-base alloy nose screwed into the body. The cartridge case M103, stannic stained and fitted with either electric primer M52A3 or M52A5; is used in the cartridge M54. The cartridge case is loaded with a propellent charge sufficient to give a breech pressure of 65,000 to 70,000 pounds psi.

b. Data.

Weight of complete round	0.63 lb.
Weight of projectile, as fired	0.28 lb.
Length of complete round	6.615 in. (max.)
Length of projectile	2.99 in.
Length of cartridge case	4.015 in.
Width of rotating band	0.203 in.
Type of base	square

CHAPTER 3

FUZES, PROPELLING CHARGES, AND PRIMERS

Section I. FUZES FOR CARTRIDGES FOR 20-MM AIRCRAFT GUNS

64. General

a. Definition. A fuze is a device used with an explosive item of ammunition to explode it at the time and under the circumstances desired. It will be noted that there is a distinction between *fuze*, as defined above, and *fuse*, a burning device for igniting a blasting cap, firecracker, or similar items.

b. Classification. Fuzes for 20-mm ammunition are of the point initiating type. For more complete information of various types of fuzes, see TM 9–1900/TO 11A–1–20.

c. Description. In general, fuzes consist of a connected series (train) of small explosive charges together with a striker or firing-pin device for initiating the action of the first charge in the train. The mechanism and explosive elements are held in a body or housing. In the case of modern point detonating (PD) fuzes, the housing (that is, the fuze contour visible above the shell) is shaped for best ballistics. In impact fuzes now in use, the explosive train usually consists of a small but highly sensitive explosive charge of primer mixture followed by a larger and less sensitive explosive charge such as lead azide, in turn followed by a still larger and still less sensitive explosive charge such as tetryl. Such charges function by successive *detonation*—hence the prevalent term *detonating fuzes*. When delay action is desired by the use of a black powder pellet, the initial charge is a primer mixture which passes a flame to the black powder and, in turn, to a detonator. Black powder is used exclusively in the time train of powder-train time fuzes and for the magazine charge of both powder-train and mechanical-types of time fuzes. Black powder, being a low explosive, differs in manner of functioning from high-explosive charges used in fuzes in that it produces its effect by *ignition*. Black powder that has been compressed to great density burns slowly, the greater the density, the slower the rate of combustion. In the functioning of a fuze, each charge by its action initiates that of the next charge in the train, the final charge in the fuze causing the detonation

of the booster which, in turn, detonates the bursting charge of the projectile.

d. Boresafety. To prevent accidental arming during handling and shipping, safety devices, such as a safety wire or a cotter pin, are used when required. In certain types of fuzes, the mechanisms are arranged so that the fuzes are said to be "boresafe" (detonator-safe). A boresafe fuze is one in which the explosive train is interrupted so that, while the projectile is still in the bore of the weapon, premature action of the bursting charge is prevented if any of the more sensitive elements (primer or detonator) function.

e. Methods of Arming.

(1) A fuze is said to be armed when it is ready to detonate the projectile, that is, when all parts are in, or are free to move to, their proper positions so that the fuze may operate in its intended manner. The principal forces used in arming fuzes are *inertia* and *centrifugal force.* In some fuzes, both these forces are used to activate safety devices; in others, only one is used.

(2) Inertia may be exhibited in several ways, each of which may be used to advantage, or each of which must be guarded against. *Setback* occurs when the projectile accelerates on being fired. It may be used to unlock safety devices. *Setforward* occurs at impact or sudden deceleration. This effect may be used to drive firing pins into primers or to drive primers against stationary firing pins.

(3) Centrifugal force occurs in spinning projectiles. This force may be utilized to actuate gear trains and to move safety devices into their proper positions in fuzes and boosters. Such fuzes and boosters are designed to operate in the rotational velocity range of the projectile-weapon combination in which they are used. Rotational speed is dependent upon the twist of the rifling and the muzzle velocity. Fuzes for projectiles fired in these weapons, then, would have different arming characteristics based on rate of rotation. Fuzes utilizing centrifugal force also must be fashioned so that they will not become unarmed as the rotational velocity decreases during flight.

Detonators.

(1) *General.* A detonator is used in the explosive train to create or transmit a detonation wave to the booster charge, booster lead, or burster. Three types of detonators are employed. One contains a primer mixture as the upper layer, for initiation by stab action of a firing pin. Another contains lead azide as the upper layer, for initiation either by flame action from a separate primer, delay pellet, time-train ring, or by detonation of a separate detonator. The third type contains a fine wire or other high-resistance electric circuit in contact with a heat-sensitive primer mixture. Passage of an electric current

through the resistance circuit generates heat, which initiates detonation in the primer mixture. Most detonator cups and disks are made of aluminum.

(2) *Identification.* Detonators make use of colors to indicate the insensitive end. Yellow is used on detonators which do not contain primer mixture or igniting mixture; green on detonators containing primer mixture; and black on detonators having a heavy disk (0.02 inch instead of 0.002 inch) on the primer mixture end. Detonators usually are not colored externally at the sensitive end. However, due to the method of sealing the disk in place and the red color specified for the sealing lacquer, a color identification is provided for the sensitive end. Coating of the end of the detonator and the entire detonator disk with the red sealing lacquer is optional, depending on the detonator manufacture. The color scheme described above applies to latest detonator construction; differences may be found on detonators of older manufacture.

65. Fuze, Point Detonating: M75

a. General. The fuze M75 was used with 20-mm high-explosive-incendiary ammunition of earlier manufacture. It is now authorized for use with the percussion-primed 20-mm HEI cartridge M97 for the 20-mm gun M3 only. It is a single-action superquick type intended to function with percussion action on impact with aircraft targets. Its design differs from the ordinary fuze in that functioning is initiated on impact by the set-forward force of the detonator charge, by pieces of metal from the body striking the detonator charge, or by compression of the air column (with the accompanying formation of heat) forward of the detonator charge, or by a combination of any or all of these. Hence, the striker or firing pin mechanism usually found in point detonating fuzes is omitted in this design.

b. Data.

Visible length	0.84 in.
Overall length	1.20 in.
Weight	348 gr.
Thread size	0.5625–32NS–1

c. Description. The fuze consists of two major parts; a body with an air space in the forepart of the fuze and a magazine containing the explosive train which is screwed into the base of the body to seat against an aluminum impact disk. The explosive train consists of a mercury fulminate detonator charge, an intermediary charge of lead azide, and a tetryl base charge (booster). Since there are no interrupter or other safety devices, the fuze is not considered a boresafe type.

d. Functioning. Upon firing, no action takes place until impact. Upon impact with sufficiently resistant targets, the head is crushed and the detonator charge functions. Action of the detonator charge in turn

initiates functioning of the lead azide intermediary charge, which causes the base charge (booster) to detonate. The booster action causes the projectile to explode.

e. Preparation for Firing. There is no preparation for firing.

66. Fuze, Point Detonating: M505 (T196E4)

a. General. The M505 (T196E4) is used with 20-mm high-explosive-incendiary ammunition. It is a single-action superquick fuze intended to function on impact with aircraft targets. The fuze will not function unless the detonator is in line with the firing pin.

b. Data.

Overall length	1.23 in.
Weight	330 gr.

c. Description. The fuze consists of a body assembly, a rotor assembly, and a booster holder assembly. The body assembly consists of an aluminum-alloy firing pin and a rotor safety spring of corrosion-resisting steel wire contained in a steel body and covered by a sheet steel cover. The cover is crimped behind the shoulder of the body so that it forms a cap which covers that portion of the fuze protruding from the projectile. The rotor assembly consists of a brass rotor containing a detonator M47 (T32). This assembly is so placed in the cavity of the body that it is held by the free leg of the rotor safety spring against a flat surface of the otherwise spherical rotor so that the detonator is "out-of-line" to provide mechanical boresafety. The booster holder assembly, which consists of a steel booster holder housing a booster M123 (T42), is screwed into the base of the fuze body.

d. Functioning. The fuze has a delayed arming distance of 20 to 35 feet from the muzzle of the gun. Prior to firing the HEI projectile, the rotor containing the detonator, which is "out-of-line" with the firing pin, and the firing pin are locked in position by the rotor safety spring. Centrifugal force, resulting from the rotation of the projectile, causes the free leg of the spring to move, thus allowing the rotor to move "in-line" with the firing pin. The movement of the rotor safety spring releases the firing pin. The firing pin is now suspended over the detonator. The close fit between the firing pin and the adjacent walls holds the firing pin in position. The fuze functions when the nose of the fuze is crushed against the target, thus forcing the firing pin against the detonator. The detonator in turn initiates the booster. The booster action causes the projectile to explode.

e. Preparation for Firing. There is no preparation for firing.

67. Fuze, Point Detonating: M505E1

a. General. The fuze M505E1 is a modification of the fuze M505 which is intended to replace the latter for use with high-explosive-incendiary ammunition for the 20-mm guns M39, M39A1, and M61. In 1957, all production of the fuze M505 was converted to the fuze M505E1.

b. Description. This fuze differs from the fuze M505 described in paragraph 66, in the design of the firing pin, in the addition of a spring retainer, and in slight modification of other parts which, in connection with the use of different sealing compounds during assembly, improve metal parts security and sealing of the fuze. The nose end of the firing pin is slightly crowned instead of spherical and the "flat" on the end of the firing pin does not have a radius on its edge. The firing pin also has a flange. When the firing pin is assembled in the fuze body, the flange is forward of the nose end of the body. The design of the body is modified to accommodate the spring retainer which retains the rotor safety spring.

c. Functioning. The arming of this fuze takes place in the same manner as that of the fuze M505. After the fuze M505E1 is armed, the flange on the firing pin prevents it from moving back against the detonator until the flange is sheared off when the nose of the fuze is crushed against the target. This fuze is intended to function when the projectile has moved an optimum distance after impact. Modifications, especially the design of the firing pin, are for the purpose of obtaining less variation in the time between impact and functioning of the fuze than have been obtained with the fuze M505.

Section II. PROPELLING CHARGES FOR CARTRIDGES FOR AIRCRAFT GUNS

68. General

a. General Discussion.

(1) *Assembly.* Propelling charges consist of solid propellants (essentially nitrocellulose plus other ingredients).

(2) *Types of grains.* To control the burning of propellant to obtain the desired performance in a particular weapon, the propellant is manufactured in several types of grain. See TM 9–1900/-TO 11A–1–20 and TM 9–1910/TO 11A–1–34 for discussion of the types of propellent grains and compositions.

b. Containers for Propelling Charges. The propellent grains comprising a propelling charge are assembled in cartridge cases so that the exact quantity of propellant may be loaded conveniently into the weapon.

c. Propelling Charges in Fixed Ammunition.

(1) *Cartridge case.* A cartridge case, made of drawn brass or steel, serves as the container for the propelling charge in the case of fixed ammunition. It has a profile and size to conform to the chamber of the weapon for which the case is intended. The head of the case is relatively thick and has a flange to permit mechanical extraction and to seat the round in the gun. Those rounds used in automatic guns usually have cartridge cases with extracting grooves instead of flanges or rims. The cartridge case holds the primer, propelling charge, and the projectile so

that the assembly can be inserted into the weapon in one operation. A secondary function is to provide for obturation. The mouth of the case is sufficiently thin to be expanded by the pressure of the burning gases to a tight fit against the side of the weapon chamber, thereby preventing the escape of gas to the rear.

(2) *Propellant.* The propelling charge in a round of fixed ammunition is loose propellant in the cartridge case.

69. Propellant for Cartridges for Aircraft Guns

The propelling charge utilized in aircraft ammunition may be either the single-base (nitrocellulose) or the double-base (nitrocellulose-nitroglycerin) type. The single-base type contains approximately 98 percent nitrocellulose and is normally extruded in a tubular shape with a single perforation. The double-base type may contain from 77 to 89 percent nitrocellulose and from 9 to 20 percent nitroglycerin by weight; this type of propellant normally is produced in the form of modified spheres of varying sizes. Both types contain other chemical agents to minimize smoke and flash, to maintain desired performance throughout long periods of shelf life under extreme climatic conditions, and to permit loading of uniform charges into the cartridges. The single-base type, which was previously loaded in all caliber .50 cartridges and currently is being loaded in 20-mm cartridges and to a limited extent in caliber .50 ammunition, is designated as the "Improved Military Rifle (IMR)" propellant. The double-base type, which is currently being loaded in some caliber .50 ammunition and some 20-mm cartridges, is commonly referred to as "Western Ball" propellant.

Section III. PRIMERS FOR CARTRIDGES FOR AIRCRAFT GUNS

70. Primer, Percussion: M36A1

This percussion primer is used in the assembly of the 20-mm cartridge case M21A1. Only cartridges for the 20-mm gun M3 utilize this primer.

71. Primer, Electric: M52A3

This primer (fig. 9) consists of a small electrical element assembly used with 20-mm ammunition in aircraft guns M24A1 and with the high-pressure test cartridge for aircraft guns M39, M39A1, and M61. It consists of a brass cup with a hole in the cupped end, into which is assembled a brass button separated from the cup by a vinylite insulator, followed by a consolidated charge of a conductive primer mixture, a shellacked foil paper disk; finally, a thin gilding-metal cup support is pressed into the body. The insulator is red in color. The charge weighs 2.75 grains (max.). The electrical path is from the face of the button exposed

through the hole in the cup, through the button, through the conductive mixture to the cup. The primer is initiated by electrical energy.

72. Primer, Electric: M52A3B1

This primer (fig. 12) is used with 20-mm ammunition, except the high-pressure test cartridge, in aircraft guns M39, M39A1, and M61. It differs from the electric primer M52A3 described in paragraph 71 in height of the cup support, which is slightly less. This results in a reduction in the overall length of the primer. This permits a cellulose case vent seal, which is used in connection with the primer, to be assembled in the primer recess of the cartridge case, between vent and primer.

73. Primer, Electric: M52A5

This primer may be used instead of the electric primer M52A3 in the high-pressure test cartridge for the 20-mm aircraft guns M39, M39A1, and M61. It differs from the primer M52A3 in the conductive primer mixture. It contains 3.00 grains (max.) of a different type of primer mixture than that used in the primer M52A3. The vinylite insulator is white in color.

74. Primer for Cartridges for Caliber .50 Aircraft Guns

Cartridges for caliber .50 aircraft guns utilize a primer having a brass or gilding-metal cup and a primer-composition pellet of sensitive explosive, a paper disk, and a brass anvil. When the firing pin strikes the primer cup and compresses the primer composition between the cup and the anvil, the composition explodes. The holes or vents in the anvil allow the flame to pass through the primer vent in the cartridge case and ignite the propellant. The armor-piercing M2, armor-piercing-incendiary T49, blank M1, high-pressure-test M1, incendiary M1, tracer M1 and M10, and headlight-tracer M17 cartridges are assembled with FA Primer No. 28. The armor-piercing-incendiary M8, armor-piercing-incendiary-tracer M20, ball M33, incendiary M23, and tracer M17 cartridges are assembled with either FA Primer No. 28 or lead styphnate-type primers.

CHAPTER 4

DEMOLITION OF AMMUNITION TO PREVENT ENEMY USE

75. General

a. Destruction of ammunition described herein, when subject to capture or abandonment, will be undertaken by the using arm only when, in the judgment of the unit commander concerned, such action is necessary in accordance with orders of, or policy established by, the Army or Air Force commander.

b. The information which follows is for guidance only. The conditions under which destruction will be effected are command decisions and may vary in each case, dependent upon a number of factors, such as the tactical situation, security classification of the ammunition (AR 380–5/ AFR 205–1), quantity and location of ammunition, facilities for accomplishing destruction, and time. In general, destruction of ammunition can be accomplished most effectively by burning or detonation, or a combination of these. Selection of the particular method of destruction requires imagination and resourcefulness in utilization of the facilities at hand under the existing circumstances. Time is usually critical.

c. If destruction to prevent enemy use is resorted to, ammunition and its components must be damaged so badly that they cannot be restored to a usable condition in the combat zone. Equally important, the *same* essential components of all ammunition must be destroyed so that the enemy cannot assemble complete rounds from undamaged components.

d. If destruction of ammunition is directed, due consideration should be given to—

(1) Accomplishment of the destruction in such a manner as to cause the greatest obstruction to enemy movement and also prevent hazard to friendly troops from fragments.

(2) Observance of appropriate safety precautions.

76. Method

Ammunition can be destroyed most quickly by burning or detonation. The following method, burning, is considered the most satisfactory for destruction of ammunition for aircraft guns to prevent enemy use. Packed high-explosive rounds and small-arms ammunition can be de-

stroyed most rapidly by burning. The ammunition may be piled in the containers (except small-arms cartridges, which should be broken out) and covered with all available flammable material such as wood, rags, and brush. Gasoline should be poured over the pile and ignited from cover. Fires should be sufficiently intense to render ammunition in metal containers unserviceable. Rounds that are not completely destroyed by fire will be classified as duds, that is, in a dangerous condition.

APPENDIX

REFERENCES

1. Publication Indexes

The following indexes should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to materiel covered in this technical manual.

Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings.	DA Pam 108–1/AFM 95–2
Military Publications:	
Armament Equipment Publications	TO 0–1–11
Index of Administrative Publications	DA Pam 310–1
Index of Blank Forms	DA Pam 310–2
Index of Graphic Training Aids and Devices.	DA Pam 310–5
Index of Supply Manuals—Ordnance Corps.	DA Pam 310–29
Index of Tables of Organization and Equipment, Tables of Organization, Type Tables of Distribution, and Tables of Allowances.	DA Pam 310–7
Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.	DA Pam 310–4
Index of Training Publications	DA Pam 310–3
Ordnance Major Items and Major Combinations and Pertinent Publications.	SB 9–1

2. Supply Manuals

The following supply manuals of the Department of the Army supply manual and the United States Air Force stock list pertain to this materiel:

a. Ammunition.

Ammunition, through 30 Millimeter	SM 9–5–1305/ USAF Stock List 1300

b. Demolition to Prevent Enemy Use.

Ammunition (Class 1375 Explosives, Bulk Propellants, and Explosive Devices.)	SM 9–5–1375/ USAF Stock List 1300

c. General.

Index of Supply Catalog and Stock List Publications.	S–2A–1D
Introduction	ORD 1

d. Maintenance and Repair.

Abrasives, Adhesives, Cleaners, Preservatives, Recoil Fluids, Special Oils, and Related Items.	ORD 3 SNL K–1
Special Tools for Ordnance Explosive Disposal Munitions, Ammunition Renovating Tools and Bomb Handling Tools.	ORD 3 SNL J–11 Sec 2
Tool Set, Maintenance (Field), Ammunition Renovation Platoon.	ORD 6 SNL J–8 Sec 4

e. Training Aid.

Special Training Device Catalog	TO 43–1–3 (USAF)

f. USAF Supply.

USAF Stock List	FSC 6910 (USAF)

3. Forms

The following forms pertain to ammunition covered in this manual:
AFTO Form 29, Unsatisfactory Report
DD Form 6, Report of Damaged or Improper Shipment

4. Other Publications

The following explanatory publications contain information pertinent to this ammunition and associated equipment.

a. Ammunition.

Ammunition Allowances for Training	AFR 50–22
Ammunition, General	TM 9–1900/TO 11A–1–20
Ammunition Inspection Guide	TM 9–1904/TO 11A–1–2
Ammunition Renovation	TM 9–1905/TO 11A–1–3
Ballistic Data, Performance of Ammunition	TM 9–1907/TO 11AA3–1–1
Caliber .60 Automatic Guns M38 (T130E4) and T130E3 and 20-mm Automatic Guns M39 (T 160E4) and T 160E3.	TM 9–2310/TO 11W1–12–3–11
Care, Handling, Preservation, and Destruction of Ammunition.	TM 9–1903/TO 11A–1–37
Military Explosives	TM 9–1910/TO 11A–1–34
Qualification and Familiarization	AR 370–5

Accident Reporting	SR 385–10–40/AFR 136–9
Identification of Inert Ammunition and Ammunition Components.	AR 385–65
Regulations for Firing Ammunition for Training, Target Practice, and Combat.	AR 385–63/AFR 50–13
Small Arms Ammunition	TM 9–1990/TO 11A13–1–101
Small Arms Ammunition: Lots and Grades.	TB 9–AMM–4/TO 11A13–1–3C
Small Arms Materiel and Associated Equipment.	TM 9–2200/TO 11W–3–1–5
Training Ammunition	T/A 23–100
b. Demolition to Prevent Enemy Use.	
Explosives and Demolitions	FM 5–25
c. General.	
Authorized Abbreviations	AR 320–50/JANAP 169
Dictionary of United States Army Terms	SR 320–5–1/AFP 5–1–1
Safeguarding Defense Information	AR 380–5/AFR 205–1
Military Symbols	FM 21–30/AFM 55–3
Military Training	FM 21–5
Ordnance Service in the Field	FM 9–5
Accident Reporting	SR 385–10–40/AFR 136–9
Techniques of Military Instruction	FM 21–6
20-mm Automatic Gun M24A1	TM 9–2024/TO 11W1–12–2–21
Lubrication	TM 9–2835
Maintenance and Care of Hand Tools	TM 9–867
Maintenance Responsibilities and Shop Operations.	AR 750–5
d. Maintenance and Repair.	
Ordnance Maintenance: Materials Used for Cleaning, Preserving, Abrading, and Cementing Ordnance Materiel, and Related Materials Including Chemicals, Lubricants, Indicators, and Hydraulic Fluids.	TM 9–1007
Painting Instructions for Field Use	TM 9–2851
Army Shipping Document	TM 38–705/AFR 70–14
Instruction Guide: Ordnance Preservation, Packaging, Packing, Storage, and Shipping.	TM 9–1005/TO 00–85–15
Report of Damaged or Improper Shipment.	AR 700–58
Marking of Oversea Supply	SR 746–30–5/AFM 75–4
Military Standard—Marking of Shipments.	MIL–STD–129

Ordnance Storage and Shipment Chart, Group A: Major Items and Major Combinations of Group A.	TB 9–OSSC–A
Preservation, Packaging, and Packing of Military Supplies and Equipment.	TM 38–230
Processing of Unboxed Self-Propelled and Towed Class II Ordnance General Supplies and Related Materiel for Shipment and Storage.	SB 9–4
Protection of Ordnance General Supplies in Open Storage.	TB ORD 379
Standards for Oversea Shipments and Domestic Issue of Ordnance Materiel Other Than Ammunition and Army Aircraft.	TB ORD 385
Bills of Lading and Related Procedures Governing Shipments by Commercial Means.	SR 55–155–1
Transportation of Explosives and Other Dangerous Articles.	AR 55–225
Transportation of Property and Personnel.	AFM 75–1

INDEX

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Ord Depots
Ports of Emb (OS)
Trans Terminal Comd
Army Terminals
OS Sup Agcy
Ord PG
Ord Arsenals
Mil Dist
Ord Proc Dist
MAAG
Mil Mis
JBUSMC
JUSMAG (Greece)

NG: State AG; units—same as Active Army.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

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